MOTOROLA

Trunked SYNTOR X™ FM Two-Way Radio

806-870 MHz
35 Watts

Instruction Manual

68P81043E50-B

COMMERCIAL WARRANTY
(STANDARD)

Motorola radio communications products are warranted to be free from defects in material and workmanship for a period of ONE (1) YEAR, (except for crystals and channel elements which are warranted for a period of ten (10) years) from the date of shipment. Parts, including crystals and channel elements, will be replaced free of charge for the full warranty period but the labor to replace defective parts will only be provided for One Hundred-Twenty (120) days from the date of shipment. Thereafter purchaser must pay for the labor involved in repairing the product or replacing the parts at the prevailing rates together with any transportation charges to or from the place where warranty service is provided. This express warranty is extended by Motorola Communications and Electronics, Inc., 1301 E. Algonquin Road, Schaumburg, Illinois 60196, to the original purchaser only, and only to those purchasing for purpose of leasing or solely for commercial, industrial, or governmental use.

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This warranty is void if:

a. the product is used in other than its normal and customary manner;
b. the product has been subject to misuse, accident, neglect or damage;
c. unauthorized alterations or repairs have been made, or unapproved parts used in the equipment.

This warranty extends only to individual products, batteries are excluded, but carry their own separate limited warranty. Because each radio system is unique, Motorola disclaims liability for range, coverage, or operation of the system as a whole under this warranty except by a separate written agreement signed by an officer of Motorola.

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In order to obtain performance of this warranty, purchaser must contact its Motorola salesperson or Motorola at the address first above shown, attention Quality Assurance Department.

This warranty applies only within the United States.

EPS-27734-O

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MOTOROLA INC.
Communications Group

TRUNKED SYNTOR X FM TWO-WAY RADIO

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FOREWORD

1. SCOPE OF MANUAL

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMR's are added to the manuals as the engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, the applicable schematic diagrams are updated.

As diagrams are updated, information about the change is incorporated into a revision column. This revision column appears in the manual next to the parts list or, in some cases, on the diagram. It lists the reference number, part number, and description of the parts removed or replaced.

3. SERVICE

Motorola's National Service Organization offers one of the finest nation-wide installation and maintenance programs available to communication equipment users. This organization includes approximately 900 authorized Motorola Service Stations (MSS) located throughout the United States, each manned by one or more trained, FCC licensed technicians.

These MSS's are independently owned and operated and were selected by Motorola to service its customers. Motorola maintenance is available on either a time and material basis or on a periodic fixed-fee type arrangement.

The administrative staff of this organization consists of national, area and district service managers and district representatives, all of whom are Motorola employees with the objective to improve the service to our customers.

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications and Electronics, Inc.
1303 E. Algonquin Road
Schaumburg, Illinois 60196

4. REPLACEMENT PARTS ORDERING

Motorola maintains a number of parts offices strategically-located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications Group products.

Orders for all parts *except* crystals, active filters, code plugs, channel elements, and "Vibrasender" ® and "Vibrasponder" ® resonant reeds should be sent to the nearest area parts center. Orders for instruction manuals should also be sent to the area parts center.

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

Orders for crystals, channel elements, active filters, code plugs, and reeds should be sent directly to the factory address listed on the following page. Crystal and channel element orders should specify the crystal or channel element type number, crystal and carrier frequency, and the chassis model number in which the part is used.

Orders for active filters, code plugs, "Vibrasender" and "Vibrasponder" resonant reeds should specify type number and frequency, and should identify the owner/operator of the communications system in which these items are to be used.

5. ADDRESSES

5.1 GENERAL OFFICES

MOTOROLA Communications and Electronics Inc.
Communications Group Parts Dept.
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60196
Phone: 312-576-3900

5.2 U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City,
San Mateo, California 94404
Phone: 415-349-3111
TWX: 910-375-3877

MIDWEST AREA PARTS
1313 E. Algonquin Road
Schaumburg, Ill. 60196
Phone: 312-576-7322
TWX: 910-693-0869

MID-ATLANTIC AREA PARTS
7230 Parkway Drive
Hanover, Maryland 20176
Phone: 301-796-8600
TWX: 710-862-1941

EAST CENTRAL AREA PARTS
12995 Snow Road,
Parma, Ohio 44130
Phone: 216-267-2210
TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road,
Glen Rock, New Jersey 07452
Phone: 201-447-4000
TWX: 710-988-5602

PACIFIC SOUTHWESTERN AREA PARTS
P.O. Box 85036
San Diego, California 92138
Phone: 714-578-2222
TWX: 910-335-1634

GULF STATES AREA PARTS
8550 Katy Freeway
Suite 128
Houston, Texas 77024
Phone: 713-932-8955

SOUTHWESTERN AREA PARTS
P.O. Box 34290
3320 Belt Line Road,
Dallas, Texas 75234
Phone: 214-241-2151
TWX: 910-860-5505

SOUTHEASTERN AREA PARTS
P.O. Box 368
Decatur, Georgia 30031
Phone: 504-981-9800
TWX: 810-766-0876

5.3 CANADIAN ORDERS

CANADIAN MOTOROLA ELECTRONICS COMPANY
National Parts Department
3125 Steeles Avenue,
East Willowdale, Ontario
Phone: 416-499-1441
TWX: 610-492-2713
Telex: 02-29944LD

5.4 ALL COUNTRIES EXCEPT U.S. AND CANADA

MOTOROLA, INC. OR MOTOROLA AMERICAS, INC.
International Parts Dept.
1313 E. Algonquin Road
Schaumburg, Illinois 60196 U.S.A.
Phone: 312-576-6492
TWX: 910-693-0869
Telex: 722443 or 722424
Cable: MOTOL PARTS

5.5 FACTORY ADDRESS FOR CRYSTAL, CHANNEL ELEMENT, ACTIVE FILTER, CODE PLUGS AND RESONANT REED ORDERS

ALL MAIL ORDERS
Motorola, Inc.
Component Products Sales & Service
P.O. Box 66191
O'Hare International Airport
Chicago, Ill. 60666

CORRESPONDENCE
Motorola, Inc.
Component Products Sales & Service
2553 N. Edgington Street
Franklin Park, Illinois 60131

PERFORMANCE SPECIFICATIONS

GENERAL

No. of Channels or Frequency Pairs	Twenty
Primary Power	12 V dc negative or positive ground. Radio is supplied for operation with negative ground vehicles. Optional cable kit permits operation with positive ground vehicles.
Dimensions	2.5" H x 11.5" W x 16.0" L (63.5 mm x 292 mm x 406 mm)
Weight	Approximately 22.5 lbs. (10.2 kg). Shipping weight approximately 37.5 lbs. (17 kg).
Metering	A single-scale 0-50 microampere meter or Motorola portable test set can be used to measure all circuits essential to checking and adjustments.

Frequency (MHz)	Model Number	EIA Intermittent Minimum RF Power Output	Operation	Maximum Battery Drain Standby @13.8 V	Maximum Battery Drain Receiver @13.8 V	Maximum Battery Drain Transmitter @13.6 V
TX: 806-825 RX: 851-870	T45VBJ5G00AK	35 W	± 12 V dc	1.1A	3.3A	13A

TRANSMITTER

Output Impedance	50 ohms
Spurious and Harmonic Emissions	More than 85 dB below carrier (for EIA spec., RS152B)
Frequency Stability	± .0002% of assigned center frequency from -40°C to + 70°C ambient (+ 25°C reference)
Modulation	15F2 & 16F3, ± 5 kHz for 100% @1000 Hz
Audio Sensitivity	0.080 V ± 3 dB for 60% maximum deviation @1000 Hz
FM Hum and Noise: EIA Method	RS152B Response: -50 dB
Audio Response	+ 1, -3 dB of 6 dB/octave pre-emphasis characteristic from 300 to 3000 Hz
Audio Distortion	Less than 2% @ 1000 Hz, 60% maximum deviation
Maximum Frequency Separation:	19 MHz
FCC Designation	CC5023 — Licensable under FCC rules Part 90 for 15F2, 16F3 and 16F9 emission

RECEIVER

Channel Spacing	25 kHz
Sensitivity: 20 dB Quieting EIA Sinad	 .35 uV .25 uV
Selectivity: EIA SINAD	-80 dB @ ± 25 kHz -90 dB @ ± 100 kHz
Spurious and Image Rejection:	-100 dB
Intermodulation: EIA SINAD	-80 dB
EIA Modulation Acceptance	± 7 kHz minimum
Input Impedance	50 ohms
Audio Output	15 watts at less than 3% distortion (into an 8 ohm load)
Maximum Frequency Separation	19 MHz
Frequency Stability	± .0002% of assigned center frequency from -40°C to + 70°C ambient (+ 25°C reference)
FCC Designation	RC0246

SPEAKER

Input Impedance	8 ohms
Dimensions	5" x 5" x 2-1/2" excluding mounting bracket (127 mm x 127 mm x 63 mm)
Weight	1-1/2 lbs. (680g)

CONTROL HEAD

Dimensions: (Excluding Mounting Bracket)	6-7/8" W x 2-1/4" H x 5-3/4" D (175 mm x 57 mm x 146 mm)
Weight	1 lb (453g)
Current Drain	150 mA
Safety	Meets or exceeds Federal Safety Standard FS-201 and SAEJ6921

TRANSISTORIZED PALM TYPE MICROPHONE

Mounting:	Hang-up Bracket Included

MODEL CHART

FOR

TRUNKED SYNTOR X

FM TWO-WAY RADIO

806-870 MHz

35 WATTS

CODE:

● = QUANTITY OF ONE SUPPLIED

ITEM	DESCRIPTION	VB1G01A	VB1G00A	T45VBJ5G00AA	T45VBJ5G00AK	TUF1081AS
	MODEL NUMBER					
	DESCRIPTION	BASIC CONTROL HEAD, NO ACCESSORIES	BASIC CONTROL HEAD, WITH ACCESSORIES	TRUNKED SYNTOR X MOBILE RADIO, BASIC MODEL	TRUNKED SYNTOR X MOBILE RADIO PACKAGE MODEL	UNIFIED CHASSIS
TCN1344A	CONTROL HEAD	●	●		●	
TRN4264A	HARDWARE KIT				●	
TRN4263A	CODE PLUG				●	
TRN4268A	CONTROL BOARD				●	
THN6400A	HOUSING				●	
TLN2169A	POWER AMPLIFIER					●
TRN4734A	ANTENNA SWITCH					●
TRN8850A	FILTER HARMONIC					●
TRN8851A	IPA					●
TRN8852A	PRE-DRIVER INTERMEDIATE POWER AMPLIFIER					●
TRN8853A	DRIVER 4.5 INTERMEDIATE POWER AMPLIFIER 20 W OUT					●
TRN8854A	FINAL AMPLIFIER					●
TRN8855A	METERING BOARD					●
TLN8856A	COUPLER DIRECTIONAL					●
TRN8857A	BUS WIRING					●
TRN8858A	P.A. HARDWARE					●
TRN8859A	CHASSIS HARDWARE					●
TLN2172A	RF INTERNAL CASTING					●
TRN8868A	PRE-AMPLIFIER					●
TRN8869A	MIXER					●
TRN8870A	VCO					●
TRN8871A	VCO BUFFER					●
TRN8872A	VCO INTERCONNECT					●
TRN8873A	HARDWARE INTERNAL CASTING					●
TLN2237A	PERSONALITY BOARD					●
TRN4275A	PERSONALITY BOARD					●
TRN4276A	ROM					●
TRN4274A	FILTER BOARD					●
TRN4361A	HARDWARE TRUNKING					●
TRN8860A	RF BOARD					●
TRN8862A	COMMON CIRCUIT BOARD					●
TUF1081AS	UNIFIED CHASSIS 35 WATT			●	●	●
HMN4002A	MICROPHONE		●		●	●
HSN4005A	SPEAKER		●		●	●
TAF6041A	ANTENNA 1/4 WAVE		●		●	●
TKN6456A	CABLE CONTROL HEAD POWER		●		●	●
TKN6458A	CABLE AND FUSE KIT		●		●	●
TKN8081A	CABLE RADIO 17 FOOT		●		●	●
TRN8874A	MOUNTING TRAY AND INSTALLATION		●	●	●	●
TRN4285A	TUNING TOOL			●	●	●
TRN4356A	COVER AND NAMEPLATE			●	●	●

EPS-30552-B

Options Table for Trunked SYNTOR X Mobile Radio

Option	Add	Delete	Applicability	Remarks
W345AB	TCN1345A	TCN1344A	All Single Subfleet Units	Provides audible tone to aid operator in setting volume.
W346AB	TCN1346A	TCN1344A	All Units Without Volume Set	Provides 5 subfleet select capability.
W347AB	TCN1347A	TCN1344A	All Package Models	Provides audible tone and 5 subfleet select capability.
W70AG	—	TAF6041A	All Package Models	Omit Antenna (14 ft. cable)
W71AB	—	HMN4002A	All Package Models	Omit microphone
W87AB	—	HSN4005A	All Package Models	Omit speaker
W109AM	TMN6152A	HMN4002A	All Package Models	Provides a handset with hangup switch.
W54AG	TKN8080A	TKN8079A	All Package Models	Provides 10 feet of positive ground cable
W54AH	TKN8083A	TKN8081A	All Package Models	Provides 17 feet of positive ground cable
W54AJ	TKN8084A	TKN8082A	All Package Models	Provides 22 feet of positive ground cable
W101AE	TKN8082A	TKN8081A	All Package Models	Provides 22 feet of negative ground cable
W496AA	TKN8079A	TKN8081A	All Package Models	Provides 10 feet of negative ground cable.
W484AA	TAF6060A	TAF6041A	All Package Models	Provides an antenna and 8 feet of cable
W414AB	TRN4432A TRN4735A	TKN6456A TKN6458A TKN8081A	All Package Models	Allows a Trunked SYNTOR X radio to operate with a Micor 800 MHz negative ground cable.
W305AA	TLN2319A TRN4569A TRN4464A	TRN4264A	All Single Subfleet Units Without Volume Set	Provides selection of up to 5 different code plugs.
W305AB	TLN2319A TRN4570A TRN4464A	TRN4265A	All Single Subfleet Units With Volume Set	Provides selection of up to 5 different code plugs.
W305AC	TLN2319A TRN4571A TRN4464A	TRN4266A	All Five Subfleet Units Without Volume Set	Provides selection of up to 5 different code plugs.
W305AD	TLN2319A TRN4572A TRN4464A	TRN4267A	All Five Subfleet Units With Volume Set	Provides selection of up to 5 different code plugs.
W306AA	TCN1358A	—	All Single Subfleet Units	Provides 15 subfleet select capability.
W307AA	TCN1359A	—	All Single Subfleet Units	Provides 7 subfleet select capability.

GENERAL SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard which applies to the use of this equipment. Proper use of this radio will result in exposure below the OSHA limit. The following precautions are recommended:

DO NOT operate the transmitter of a mobile radio when someone outside the vehicle is within two feet (0.6 meter) of the antenna.

DO NOT operate the transmitter of a fixed radio (base station, microwave and rural telephone rf equipment) or marine radio when someone is within two feet (0.6 meter) of the antenna.

DO NOT operate the transmitter of any radio unless all RF connectors are secure and any open connectors are properly terminated.

In addition,

DO NOT operate this equipment near electrical blasting caps or in an explosive atmosphere.

All equipment must be properly grounded according to Motorola installation instructions for safe operation.

All equipment should be serviced only by a qualified technician.

Refer to the appropriate section of the product service manual for additional pertinent safety information.

EPS-28750-O

1. INTRODUCTION

The 800 MHz Trunked SYNTOR X Communications System consists of control stations, mobile units, base repeaters, and a system central controller. (The term "trunking" essentially means the "automatic sharing" of a group of communications paths (trunks) among a large number of users.) The 800 MHz Trunked SYNTOR X Communication System provides a variety of features and capabilities many of which cannot be obtained in conventional systems. The features can be broken down into the following major categories:

- system manager capabilities
- system user capabilities
- system reliability capabilities
- system access features
- system expansion features

2. SYSTEM MANAGER CAPABILITIES

FCC Docket No. 18262 stipulates that users or system operators needing six or more channels in the 800 MHz spectrum will be required to operate trunked systems. Moreover, trunked systems from a minimum of 5 channels to a maximum of 20 channels are authorized. Motorola's basic trunked system consists of 5 channels but is provided with the built-in capability of being expandable up to 20 channels.

3. USER CALL CAPABILITIES

3.1 SUBFLEET CALLS

The subfleet call is the basic element that is served by the Trunked Communications System, and the subfleet call is the standard call capability. A subfleet call allows all the radio units to monitor and initiate transmissions within the subfleet only. This provides the effect of a private channel down to the subfleet call.

3.2 FLEET CALL (OPTIONAL)

3.2.1 This option allows the user of a Motorola Trunked SYNTOR X Communications System to initiate communication with all members of the fleet

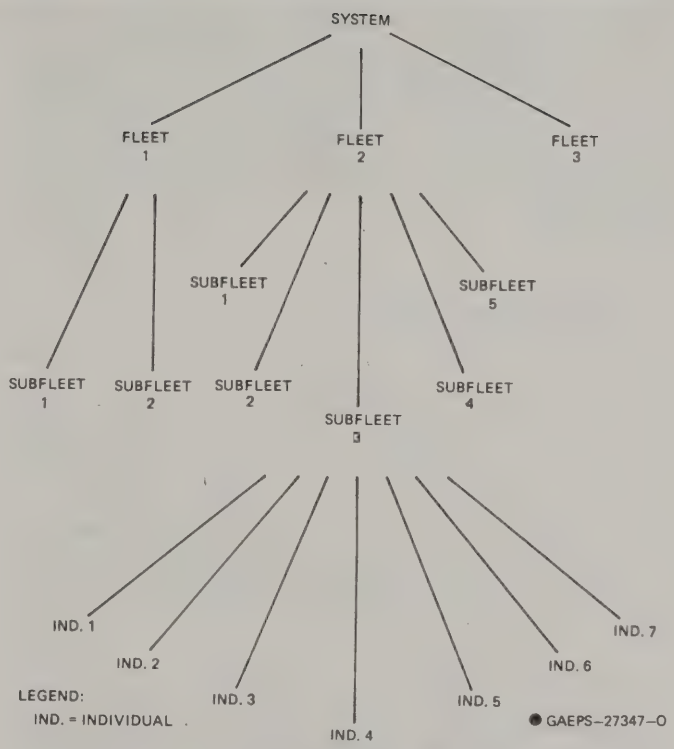

Figure 1. Typical Fleet/Subfleet Configuration.

simultaneously without regard to subfleet boundaries. The unit will monitor any subfleet call made within the fleet on a FIFO (first-in-first-out) basis. Fleet privacy is insured since no two fleets would ever be assigned the same voice channel at the same time, thus making it impossible for any units in one fleet to interfere with those of another fleet. This eliminates the need to monitor other users before starting transmissions. (See Figure 1 for a typical fleet/subfleet configuration.)

3.2.2 An optional selector switch allows mobile units of the same fleet to selectively move between subfleets within the fleet. Moreover, the dispatchers (and select mobile stations) can be given both fleet-call and subfleet-call capabilities by means of a single selector switch. Fleet call in a subdivided fleet allows the dispatcher or mobile operator to transmit a message to all the units in his fleet without regard for subfleet boundaries.

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3.2.3 The fleet and subfleet selections are made via the subfleet selector switch. The basic control station can be programmed either to operate within a specified subfleet or be given a fleet call capability such that its transmissions would be heard in all subfleets, and its receiver would monitor activity in all subfleets on a FIFO basis.

3.2.4 A trunked control station equipped for multiple subfleet operation receives only one subfleet at a time. Consequently, if the dispatcher sets his selector switch to one subfleet, he will not receive calls originating in a different subfleet. The same holds true for fleet call operations. If there is simultaneous operation in different subfleets, a trunked control station placed in the fleet-call mode will receive only one subfleet, since the control station receives the subfleets on a FIFO basis. Multiple control stations allow the dispatcher to hear calls in more than one subfleet simultaneously.

4. SYSTEM RELIABILITY

4.1 MULTIPLE CHANNELS

4.1.1 The multi-channel aspect of the Motorola Trunked SYNTOR X Communications System provides a high degree of system reliability. Since channels are assigned as needed and no user is dependent on any given channel for his communciations, the failure of any one channel will probably not be apparent to the users.

4.1.2 When a channel fails, the system controller is programmed to assign only the working channels. Only during the busiest periods of the system would the users notice heavier-than-normal channel loadings and longer user access times caused by the loss of a channel.

4.2 BACK-UP CONTROL CHANNELS

The failure of an individual channel would not (in most cases) lead to a degradation of system performance. If the control channel fails, however, the whole system could go off the air. To prevent this, the system controller is programmed to assign one of the voice channels as a substitute control channel. Under such conditions, the mobile units will recognize the new control channel and system operation will proceed without interruption.

4.3 RECEIVER INTERFERENCE

A trunked repeater may be jammed by the receipt of an unauthorized signal. The controller is programmed to turn off the repeater whenever it detects a carrier on a channel that has not been assigned to members of the system. The repeater will be re-assigned only when the unwanted carrier is removed.

4.4 TRANSMITTER FAILURE

The system controller is programmed to detect any loss or reduction in the output power of any of the repeater transmitters. When the transmitter output power falls below a certain level, the channel will be automatically, taken out of service.

4.5 SYSTEM SELF-DIAGNOSTICS

The system self-diagnostics comprise central controller checks, repeater receiver interface checks, and repeater transmitter interface checks. The detection of a fault can trigger visual and/or audible alarms at the controller site. Relays are used for implementing these alarm functions.

4.6 FAILSOFT

4.6.1 A failsoft feature has been incorporated into the system to insure continued communications whenever the system central controller develops a fault. When the controller becomes inoperative, the mobile units will automatically revert to their preassigned failsoft channels (system voice channels) and will be capable of conventional repeater operation on these channels. Once in the failsoft mode, however, the system will lose most of its fleet and subfleet privacy, but this privacy will be resumed as soon as normal system operation is restored. A warning tone is heard every ten seconds during failsoft operation.

4.6.2 A subaudible data handshake is activated on each voice channel whenever the repeaters go into failsoft mode. This will insure that the mobile units will not operate in the failsoft mode simply because they went out of range of the central. Thus the mobile units will remain operative as long as they receive the subaudible data.

4.6.3 Since failsoft channel assignments are a function of the mobile unit code plug, they must be specified at the time of code plug programming. These assignments are made such that all the system mobile units are evenly distributed over the system voice channels. Members of the same fleet or subfleet should be assigned to the same channel. Mobile units can be denied failsoft operation.

5. SYSTEM ACCESS FEATURES

5.1 TALK PROHIBIT TONES

There will be times when all the channels in the trunked communications system are busy. Since it is not possible to monitor other users on a trunked system, mobile operators will be provided with telephone-type busy or talk-prohibit tones. Any user depressing his PTT pushbutton while the system channels are busy will receive a talk-prohibit tone. This tone is also provided

whenever the mobile operator cannot access the system because of the following reasons:

- the mobile unit is out of range
- the system is out of service

5.2 BUSY LIGHT

All mobile units are provided with a BUSY light indication which is activated only when the PTT pushbutton is depressed at a time when all channels are busy. The BUSY light will remain turned on until a call back is sent to the operator (see next paragraph). A mobile operator who receives a talk prohibit tone without a BUSY light indication can assume that his unit failed to gain access to the system.

5.3 BUSY QUEUE/CALL BACK

Users requesting system access at a time when all voice channels are in use will be put in a waiting queue and will be served on a FIFO basis. When a channel becomes free, the system controller will send a call back tone to the first mobile unit in the waiting queue. The call back consists of a short series of beeping tones which can be heard by the mobile operator. This feature permits the operator who receives a busy indication to release his PTT pushbutton and wait for the call back signal rather than repeatedly depressing his PTT pushbutton in an attempt to access a system channel. These features operate only when the mobile unit is within range.

5.4 TALK-PERMIT TONE (OPTIONAL)

This feature provides a mobile operator with a brief (200 ms) series of tones whenever he keys up a voice channel. The talk-permit tones, which are identical to the call back tones, provide the operator with an indication that he has keyed up on a voice channel. Since this feature is a code-plug-implementable option, it can provided on a select number of mobile units as desired.

5.5 AUTOMATIC RETRY

A channel request is initiated by depressing the PTT pushbutton and causing the transmitter to send a burst of data to the central controller via the control channel. Since a single burst of data may not get through because of adverse signaling conditions or interference, the radio unit is designed to keep on sending channel requests--until a request acknowledgment is received from the central controller or until four seconds have elapsed. These attempts will continue even if the operator releases his PTT switch. Thus, the operator is not required to continually depress his PTT pushbutton in an attempt to gain access to the system.

5.6 RECENT USER PRIORITY

This feature provides users who have been assigned voice channels with priority over other system users, thus insuring that a fleet engaged in a message transmission will get system access priority even if there is a short delay between transmissions. This reduces the possibility of a channel not becoming available during an exchange of transmissions if a mobile operator is slow in responding.

5.7 MISDIRECTED MOBILE PROTECTION

To insure that no mobile unit from one fleet will accidentally be assigned to a voice channel used by a different fleet, a subaudible data handshake is implemented in the system. Once a fleet is assigned to a voice channel, the repeater of the assigned channel will keep on sending an outbound stream of subaudible data containing the unique fleet or subfleet ID of the units using the channel. Should a unit from a different fleet or subfleet be accidentally assigned to the same channel, the unit would automatically revert to the control channel since it does not have the proper ID. The audio of the errant mobile unit would be muted and the transmitter disabled for the fraction of a second that it actually spent on the wrong channel and thus could neither monitor nor key up on the wrong channel.

5.8 CONTINUOUS ASSIGNMENT UPDATING

Once a voice channel is assigned to a fleet or subfleet, the control channel will keep on transmitting the channel assignment for as long as that fleet is using the channel. This insures that a mobile just coming into service will be sent over to the appropriate channel to join the rest of his fleet. The assignment updating information will be sent serially, and the total time that will be required by the control channel to run through 19 assignments on a 20-channel system is approximately 500 milliseconds.

6. SYSTEM EXPANSION FEATURES

6.1 ORDERLY SYSTEM EXPANSION

Motorola Trunked SYNTOR X Communications Systems are structured such that they allow the addition of mobile units without affecting the operation and privacy of mobile units currently using the system. Mobile units can be added to an existing user fleet or new users can be added without the need for any system changes--within the capacity limitations of the system.

To increase the number of channels in a Trunked SYNTOR X system, all that need be done is to add the necessary base station and central controller equipment. It is not necessary to modify any Trunked SYNTOR X mobile or control station to add an additional channel. The Trunked SYNTOR X will automatically accommodate the added voice channel.

multiple-frequency operation since frequencies can be changed or added by plugging in a different code plug in the control head.

8.1.4 Improved Transmitter and Receiver Performance

The Trunked SYNTOR X transmitter provides audio distortion rated at less than 2% (at 1000 Hz, 60% maximum deviation) and a frequency stability of ±0.0002% of assigned center frequency (over an ambient temperature range from -40°C to +70°C). Spurious and harmonic emissions are rated at greater than 85 dB below carrier. Sensitivity of the receiver is rated at 0.25 microvolts (EIA SINAD), and spurious and image rejection is -100 dB. Frequency stability is identical to that of the transmitter.

8.2 OPTIONAL FEATURES

The Trunked SYNTOR X radio may include the following optional features:

- Volume Set
- Subfleet Select
- Programmable Time-Out Timer

8.2.1 Volume Set

The volume set feature allows the operator to set the radio volume to a desirable level.

8.2.2 Subfleet Select

This option allows the operator to communicate with one of up to five individual subfleets or an entire fleetwide calling group.

8.2.3 Programmable Time-Out Timer

The code plug can be programmed to cause the transmitter to cease transmission at timer lengths of 0 (no time-out), 15, 30, or 60 seconds.

8.2.4 Multiple System Select

The multiple system select option permits an operator to access one of up to five different trunked systems or fleets in a local area or in various geographic regions.

8.2.5 Seven and 15 Subfleet Select Options

These options allow an operator to select (1) one of up to seven subfleets or the entire fleet or (2) one of up to 15 subfleets or the entire fleet. When used in conjunction with the multiple system select options, these fleet/subfleet combinations can be accessed in any one of up to five systems.

9. ELECTRICAL CHARACTERISTICS

The basic Trunked SYNTOR X radio comes fully equipped for up to 20 channel operation. The unit operates from a negative-ground, 12-volt dc source. A standard control head, speaker, microphone with a hang-up bracket, 1/4-wave unity gain antenna with a 14-foot cable, and a 17-foot negative-ground cable kit are included.

9.1 CIRCUIT BLOCKS

The Trunked SYNTOR X radio is grouped into the following blocks: (a) control head, (b) trunked personality board, (c) trunked filter board, (d) common circuits board, (e) 35-watt power amplifier, (f) radio frequency (rf) board, and (g) internal casting. The internal casting comprises a voltage-controlled oscillator (VCO), preamplifier, mixer, 6-pole filter, 2-pole and 3-pole filter, and a buffer.

9.2 FUNCTIONAL DESCRIPTION

The Trunked SYNTOR X radio can be functionally divided into five parts: (a) microcomputer, (b) control head, (c) frequency synthesizer, (d) receiver, and (e) transmitter. The microcomputer circuits are contained on the personality board; the frequency synthesizer circuits are contained on the common circuits board, rf board, and internal casting; the receiver circuits are contained on the trunked personality board, common circuits board, rf board, and internal casting; and the transmitter circuits are contained on the common circuits board and power amplifier. A brief description of each functional segment is provided below; further description is provided in the section associated with the circuit in question.

9.2.1 Microcomputer

The trunked personality board contains the microcomputer system. The microcomputer consists of a Motorola MC6803 8-bit microprocessor, a read only memory that contains the operating program, and associated supporting and control circuitry. The microcomputer controls all operations of the trunked radio from lighting the control panel indicators to frequency selection.

9.2.2 Control Head

The trunked control board in the control head accepts data in parallel form from the code plug and the various switches and converts the data into serial form before forwarding it to the radio logic circuitry. Likewise, serial data from the radio logic circuitry is received by the trunked control board and converted into parallel data for display on the indicator lights. Transmission of serial data to the radio is achieved by means of a "polled" protocol in which the radio requests the trunked control board for data, and the control board responds by forwarding the appropriate information. The trunked control board includes: (a) a

UART (Universal Asynchronous Receiver/Transmitter), (b) a code plug, (c) a serial data link receiver and transmitter, (d) a +5-volt regulator, (e) a watchdog timer, and, (f) switch interfaces.

9.2.3 Frequency Synthesizer

The frequency synthesizer is used to generate the first receive injection frequency and transmitter carrier. In the receive mode, the synthesizer locks on a frequency that is 53.9 MHz (first i-f) lower than the desired receive frequency. In the transmit mode, the synthesizer locks on the transmit output frequency. The synthesizer employs a phase-locked loop (PLL) that operates at half the desired output frequency and consists of: a 14.4 MHz reference oscillator, a low- noise voltage controlled oscillator (VCO), a high-speed programmable divide-by-3-or-4 variable modulus prescaler, a lower-speed programmable divider, a sample-and-hold phase detector, and a loop adaptive filter. It also uses a buffer doubler/splitter that doubles the VCO output frequency for use by the radio. The 14.4 MHz reference oscillator output is applied, via an injection tripler, to the second mixer of the receiver, where it serves as the low-side second injection frequency. Microphone audio from the trunked personality board is applied to the IDC (instantaneous deviation control) circuitry located on the common circuits board. The IDC circuits process the audio to ensure that the proper level of audio drive is supplied to the frequency synthesizer.

9.2.4 Receiver

The incoming rf signals are applied to the rf preamplifier via the antenna relay and a 2-pole preselector filter. The preamplifier output passes through a 6-pole preselector filter and is then applied to the first mixer stage. The selectivity of the two filters is such that it prevents high-level, out-of-band signals from degrading receiver performance. The frequency synthesizer rf output is doubled and then applied to the first mixer via a 3-pole injection filter. The first mixer generates an i-f (intermediate frequency) of 53.9 MHz that is sufficiently amplified by two amplifiers so that it will be able to drive the second mixer. The second mixer uses the 53.9 MHz signal and a 43.2 MHz signal from an injection tripler to generate a 10.7 MHz i-f. After amplification, the 10.7 MHz signal passes to the limiter/detector stage. The receiver uses two 4-pole crystal filters that substantially attenuate signals outside the predetermined receiver bandpass range. The detected audio is fed to audio amplifiers on the trunked personality board. When the microcomputer enables the audio enable switch, the audio is amplified and applied to the speaker.

9.2.5 Transmitter

The rf output generated by the frequency synthesizer at the required transmit frequency is applied to the controlled stage of the intermediate power amplifier (IPA) of the transmitter. The rf signal passes from the IPA to a power amplifier, via a coaxial cable, and is applied to the predriver stage. The predriver stage is followed by a driver stage, and both stages provide sufficient output to drive the final power amplifier. The predriver and driver stages are mounted on separate microstrip assemblies. The transmitter is provided with a temperature-sensing circuit that protects the final power amplifier against damaging high temperatures. The temperature-sensing circuit works in conjunction with the power control circuit located on the common circuits board. The power control circuits provide power leveling and protection to the final power amplifier stage of the transmitter. These circuits receive forward and reflected power data from a directional coupler that is electrically located between the final power amplifier stage and the harmonic filter assembly. The transmitter IPA receives a control voltage that is controlled by the forward power, VSWR, and final PA temperature data. When the control voltage changes, it causes a change in the gain of the first stage of the IPA and, hence, in the rf drive level to the final power amplifier.

10. PRIMARY POWER SOURCE

The Trunked SYNTOR X radio is designed to operate from a negative-ground, 12-volt dc source. However, an optional cable kit allows the radio to operate from positive-ground sources. A built-in floating ground is used by the radio.

11. PHYSICAL CHARACTERISTICS

The Trunked SYNTOR X electronic circuits are enclosed in a rugged low-profile housing. One end of the housing contains the antenna connector, lockswitch, main cable connector, and handle. The other ekd contains the heat-sink fins, which provide cooling for the power amplifier circuits. The various radio circuits have been provided with the proper isolation by using partitions and shielding covers. The radio employs an easy-to-snap-on top cover and a bottom cover that is secured to the radio by means of four screws. A mounting tray is also provided with the radio.

MOTOROLA INC.
Communications
Group

OPERATING INSTRUCTIONS

1. INTRODUCTION

The 800 MHz Trunked SYNTOR X mobile unit consists of:

- trunk-mountable radio
- trunked control head (a standard unit or one with options)
- microphone
- speaker
- antenna
- interconnecting cable

2. CONTROL HEAD

2.1 A trunked mobile unit can be provided with either a standard trunked control head or a head equipped with a selected number of options. A standard control head is provided with the following controls and indicator lights:

- POWER on/off button
- VOLUME thumbwheel control
- power ON indicator light
- transmit indicator light
- BUSY indicator light

2.2 Options include:

- VOLUME SET button
- subfleet and associated indicator lights
- multiple system select
- seven or 15 subfleet select

3. OPERATION

3.1 STANDARD CONTROL HEAD

Assuming that the mobile unit has been properly installed and is in good operational condition, proceed as follows:

Step 1. Push the POWER on/off button; the power ON indicator should light. (On optional control heads, the selected subfleet indicator will also light.)

Step 2. Turn the VOLUME control to the right, near midpoint, to insure that you will be able to hear an incoming call. (No audio is present until a call is received.) Once a call is received, the desired volume can be set by turning the VOLUME control to the left or right.

Step 3. Now you are in a position to communicate in accordance with the information entered into the code plug. When the microphone PTT switch is depressed, a channel request is entered. If a channel is available, the transmitter is keyed, the transmit indicator lights, and you may talk immediately.

NOTE

When the transmitter is initially keyed to send a channel request, the transmit indicator will not light because the transmitter is keyed only for a very brief period of time. When the transmit light turns on, it is an indication that the transmitter is keyed continuously for voice communications.

Step 4. If all channels are busy when the microphone PTT button is depressed, a "talk prohibit" tone is audible in the speaker. This tone is similiar to the busy tone heard on a standard telephone. The control head BUSY indicator will light. Release the PTT button and wait for a "beep" tone indicating that a channel has become available. The BUSY light will turn off when the "beep" tone is sounded. Depress the PTT switch and talk into the microphone.

If the mobile is out of range of the system when the PTT switch is depressed, the "talk prohibit" tone will be audible but the BUSY indicator will not light. Release the PTT switch and try again after the mobile is driven into a different area.

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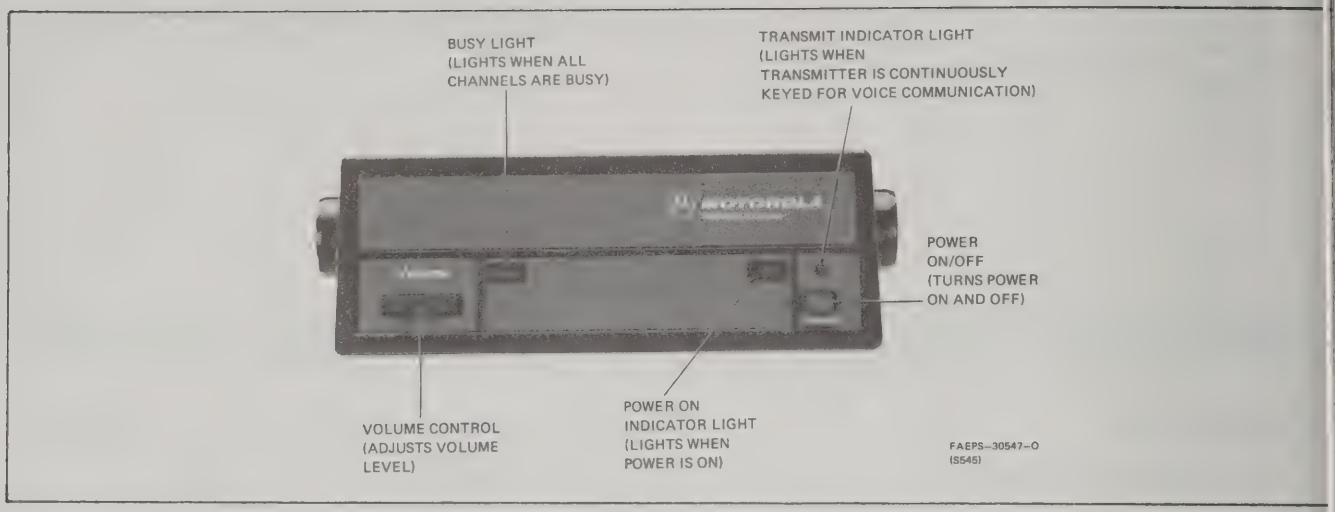


Figure 1. Standard Trunked Control Head.

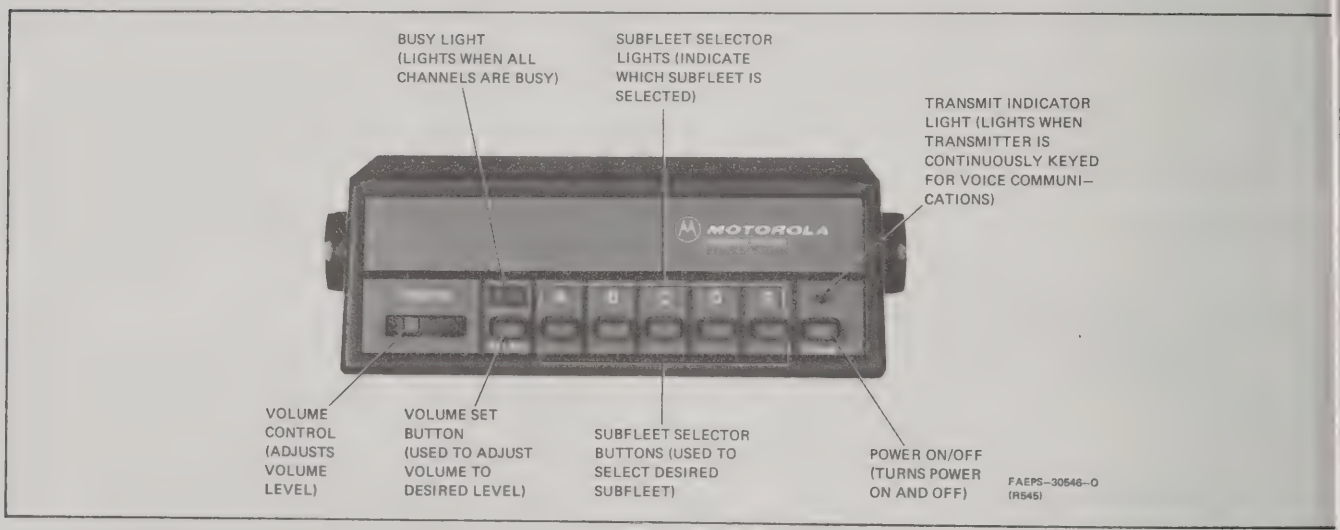


Figure 2. Trunked Control Head with Options.

3.2 CONTROL HEAD WITH OPTIONS

3.2.1 Volume Set Option

Step 1. Depress the VOLUME SET button; a continuous tone will be heard.

Step 2. Turn the VOLUME control to the left or the right until the desired audio level is reached.

Step 3. Depress the VOLUME SET button again to release it. If this button is not released, the audible tone will persist. Incoming calls and outgoing transmissions, however, will override the tone.

3.2.2 Subfleet Selector Option

This option allows the operator to communicat with the desired subfleet by depressing the appropriat subfleet selector button (A through E). When th POWER on/off button is depressed, the subfleet in dicators will illuminate. Four lights will be low intensity the fifth light will have a high intensity level and will in dicate which subfleet is currently selected. To select a different subfleet, depress the desired subfleet button The associated indicator light will illuminate at high in tensity. The mechanism of the selector buttons is such that only one button can be depressed at a time. In formation programmed into the code plug determines which subfleet is selected by a particular button. If the operator does not depress any selector buttons, the unit will default and act as through the first selector button (from the left as seen from the front) were depressed. The associated light, light A, will indicate this condition by illuminating at high intensity.

3.2.3 Multiple System Select

Figure 3 shows a trunked control head with the volume set and five subfleet option in addition to the W305AD multiple system select option. With this combination, an operator may select any one of up to five subfleets or five fleet/subfleet combinations in any one of five systems.

Any one of up to five systems or fleets can be selected by depressing the desired system select pushbutton. The associated indicator light illuminates at high intensity. If no pushbutton is depressed, system one is selected. There is a wait of approximately one second before the mobile can receive and transmit calls after a system selection is made.

Once the system is selected, the subfleet selector pushbuttons may be depressed to access the individual subfleet or fleet desired in the system.

3.2.4 Seven or 15 Subfleet Select

(Refer to Figure 4.)

Any one of up to 15 subfleets or the entire fleet may be selected by depressing the desired momentary pushbutton. The associated indicator light illuminates at high intensity. The seven subfleet option (not shown) is continuously back lit. However, because of possible heat build-up, the 15 subfleet option is not back lit.

If no pushbuttons are depressed, a predetermined subfleet or entire fleet select position is accessed. This is accomplished by the pre-connection of a gray jumper wire to one of eight bubble head pins on the subfleet select boards (one of 16 bubble head pins on the two boards of a 15 subfleet select unit) inside of the option housing. This procedure is normally done either at the factory or by a field technician.

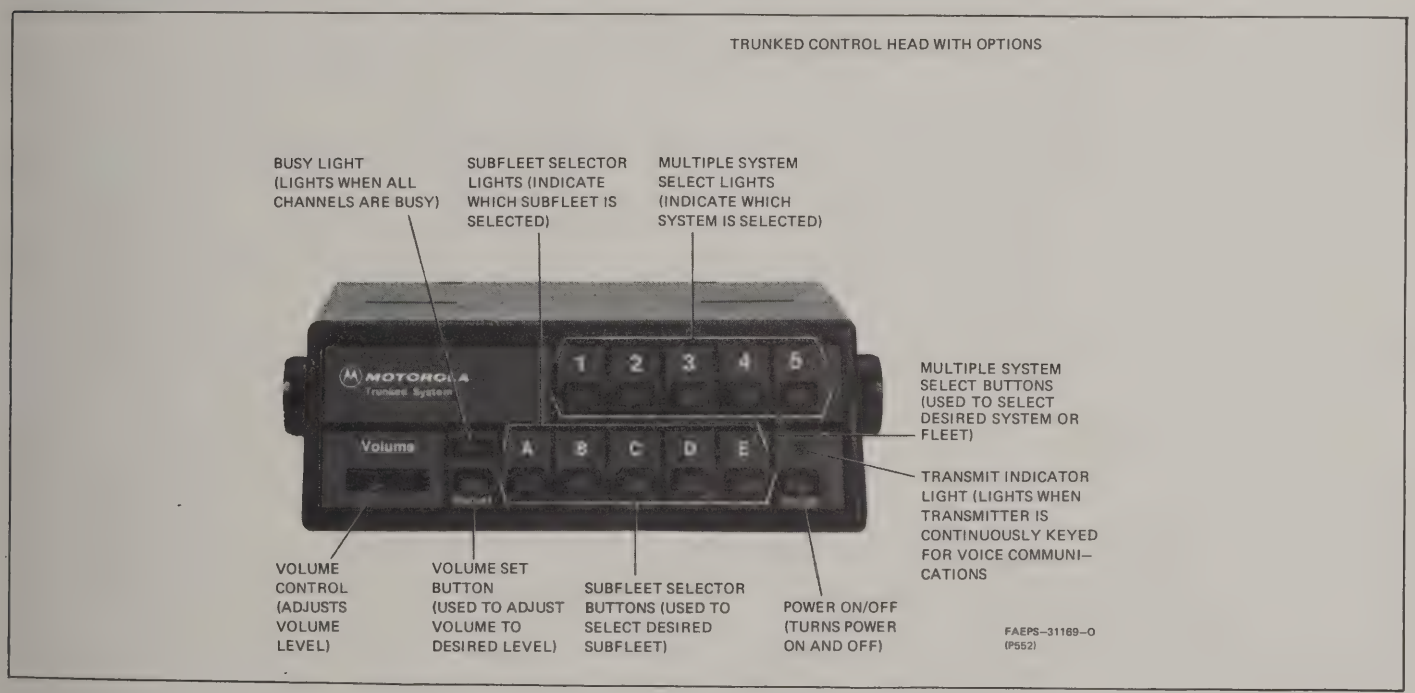


Figure 3. Trunked SYNTOR X Control Head with Multiple System Select Option W305AD and Five Subfleet Select and Volume Set Options

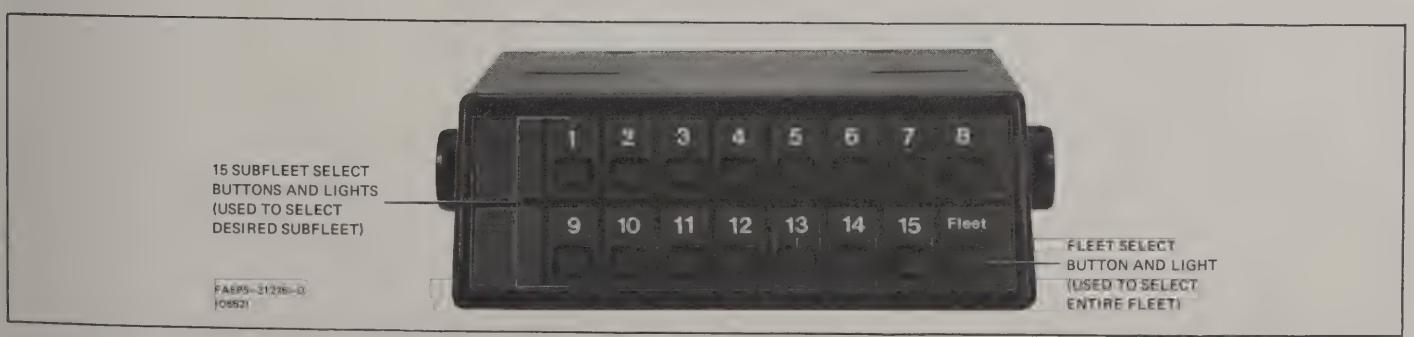


Figure 4.
Trunked SYNTOR X 15 Subfleet Select Option W306AA (Front View)

INSTALLATION

1. SERVICE

Should you wish to purchase a service contract for your Motorola equipment, contact your Motorola Service Representative, or write to:

National Service Manager
Motorola Communications Group
1301 E. Algonquin Rd.
Schaumburg, Illinois 60196

2. FCC REQUIREMENTS

2.1 You are required by the FCC to obtain a station license for your radio equipment before transmitting. No operating license or permit is required. The station licensee is responsible for ensuring that the transmitter power, frequency, and deviation are within the maximum limits allowed by the station license.

2.2 The FCC requires that these checks and any transmitter adjustments be performed only by persons holding a valid 1st or 2nd class commercial radiotelephone operators license or by personnel working under their immediate supervision.

2.3 The power input to the final radio frequency stage shall not exceed the maximum figure specified on the current station authorization. This power input shall be measured and the results recorded:

- when the transmitter is initially installed.
- when any change is made in the transmitter which may increase the power input.
- at intervals not to exceed one year.

2.4 Frequency and deviation of a transmitter must be checked:

- when it is initially installed.
- when any change is made in the transmitter which may affect the carrier frequency or modulation characteristics.
- at intervals not to exceed one year.

3. PRE-INSTALLATION TESTS

Although the equipment has been accurately aligned at the factory, it is possible that mishandling in transit may have disturbed some of the adjustments. In addition, FCC regulations require transmitter frequency and deviation to be checked at installation. It is essential therefore, that a pre-operational check be made to assure proper operation. For complete checkout, follow the sequence of tests presented below.

NOTE

Complete information for performing the tests are fully outlined in the General Maintenance/Troubleshooting section of this instruction manual.

Step 1. Check the highest transmit frequency (highest repeater frequency) and adjust as required. This will also correct the receive frequency errors caused by the reference oscillator.

Step 2. Measure the transmit power output at the highest transmit frequency (highest repeater frequency) and adjust as required.

Step 3. Measure the transmitter deviation at the highest transmit frequency (highest repeater frequency) and make the necessary adjustments as required.

Step 4. Measure the transmit frequency.

Step 5. Measure the receive frequency.

Step 6. Measure the 20 dB quieting signal level.

Step 7. Check the antenna VSWR after installing it in the vehicle.

4. INSTALLATION PLANNING

Refer to the installation planning diagram (Figure 1) which provides information on the antenna location, operator's controls, radio set location, control and power cable routing, transmitter control power lead, receiver control power lead, primary power connections, and other accessories.

WARNING

For vehicles equipped with electronic anti-skid braking systems, refer to "Anti-Skid Braking Precautions", Motorola publication number 68P81109E34. This document is available free of charge.

4.1 ANTENNA LOCATION

The best location for the antenna is at the center of the vehicle roof. A good alternate location is at the center of the trunk lid. Be sure that the antenna cable can be acceptably routed to the radio set before mounting the antenna. Refer to the antenna instruction manual for details.

CAUTION

Antennas must be installed at least two feet (0.6 meter) from vehicle operators and passengers unless shielded by a metallic surface.

4.2 RADIO SET LOCATION

In most vehicles, the best location for the radio unit is the floor of the trunk compartment. When considering location make certain that the radio set is protected from dirt and moisture and that there is sufficient space around the radio to allow adequate cooling and removal of the unit.

4.3 OPERATOR'S CONTROLS

Recommended mounting surfaces for the control head, microphone hangup clip and speaker include the following: under the dashboard, on the transmission hump, or on the center console. In addition, the speaker may be mounted on the firewall. Adjustable trunnions are provided for the mounting of the control head and the speaker which accommodate a large number of mounting positions. Holes for mounting the hangup clip are also provided on the under side of the control head. The installation must not interfere with the operation of the vehicle or its accessories, nor disturb passenger seating or leg space. The control head and the microphone hangup clip must be within convenient reach of the user(s).

4.4 CONTROL AND POWER CABLE ROUTING

Many vehicles are equipped with wire troughs in the door sills. If the vehicle has this feature, use it to provide maximum protection for the cable and to simplify the cable installation. In vehicles without wiring troughs, the control and power cables must be routed where they are protected from pinching, sharp edges, and crushing. One suggested route is along one side of the drive shaft hump under the carpet. Be sure grommets are used whenever the cable must pass through a hole in a metal panel.

4.5 PRIMARY POWER CONNECTIONS (RED)

The best power connection point for the battery hot primary power lead is at the hot battery terminal. Points connected directly to the battery terminal with sufficient current-handling capabilities may also be used. Make certain that the point chosen remains close to 13.6 volts; some systems switch to a higher-than-normal voltage during starting.

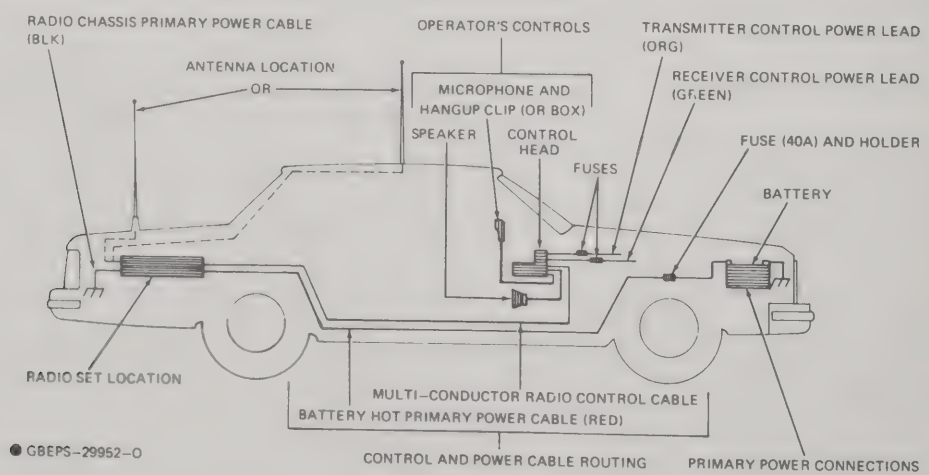


Figure 1. Installation Planning

4.6 TRANSMITTER CONTROL POWER LEAD (ORANGE)

This lead may be connected to the ignition switch (recommended) or directly to a battery hot supply. Refer to the cable connections diagram.

4.7 RECEIVER CONTROL POWER LEAD (GREEN)

This lead may be connected to a battery hot supply (recommended) or to the ignition switch. Refer to the cable connections diagram.

4.8 RADIO CHASSIS PRIMARY POWER CABLE (BLACK)

The radio set chassis primary power cable should be connected to a good ground point on the vehicle chassis.

5. CABLE ROUTING

(Refer to Figures 1 and 2.)

CAUTION

In positive ground vehicles, a positive ground cable kit must be used. A negative ground cable kit can be converted for positive ground operation if required.

CAUTION

Before the cable is routed (after unpacking) remove the green and orange fused power leads from the black connector block that connects to the control head.

Step 1. Determine the position that the radio set will occupy in the trunk compartment and leave enough slack cable to permit the plug to be easily connected or disconnected from the radio set.

Step 2. Work from the trunk space forward. In some cars there is enough room below the fiberboard trunk partition to admit the cables. If this is not the case, make an opening through the partition. Remove the back seat.

Step 3. The control head end of the multi-conductor cable kit is terminated in one black and one yellow connector housing. If the leads must be removed from the connector housing to permit passage of the cable, use the following procedures:

- Each cable kit has a contact removal tool (Motorola part no. 66C84699B01) taped to it. Slide the small end of the tool into the front of the individual contact position so that the tab of the female contact is pushed up and the contact may be removed from the housing by carefully pulling it out with the wire. Repeat this operation until all wires are removed from each connector housing.

- Tape the female contacts into a small bundle. Pass it and the long red power cable into the passenger compartment. After reaching the control head position reinsert the female contacts into the proper contact positions in the connector housings.

Step 4. Pull the cables into the back seat area, under the floor mats and front seat, out to the top of the floor mat under the dash. Where no specific channel is provided, route the cables under the floor mat along the side of the drive-shaft tunnel. Pull the control head end of the multi-conductor cable to the approximate location of the control head. Route the red power cable into the engine compartment through any convenient hole already in the firewall. If necessary, make a 1/2-inch diameter hole elsewhere in the firewall, install the supplied grommet, and route the cable through the grommet.

Step 5. Pull the red power cable into the engine compartment. A cable fuse kit has been supplied with a ring tongue lug on one end and an in-line fuseholder on the other. A small section of heat-shrinkable tubing is supplied with each cable. Any excess red cable length should be trimmed at this time. Slide the heat-shrinkable tubing over the red power lead from the radio. Slide the strapped portion of the red cable into the end of the in-line fuseholder and crimp the joint using a Burndy Model Y10B (indent "U" crimp). If this tool is not available, soldering is required.

Step 6. Slide the heat-shrinkable tubing over the connection and shrink the tubing using a Motorola Model ST697 Heat Gun or equivalent heated air source. Remove the fuse from the fuseholder and reconnect the holder. Fasten the ring-tongue lug on the end of the cable to the battery's ungrounded terminal or to some point directly connected to the ungrounded terminal of the battery (such as the starter solenoid). Move the in-line fuseholder to a convenient location on one of the sheet metal parts of the engine compartment. Center punch and drill a 9/64" (.140") hole through the mounting surface. Then use the supplied #10-16-3/4" self-tapping sheet metal screw to mount the bracket. Do not replace the fuse until the entire installation of the radio set is complete.

Step 7. The control head power cable kit contains two separate wires, each equipped with an in-line fuse. The orange wire is 69 inches long and the green wire is 100 inches long. Taped to the lugless end of each cable are a crimp-on type ring tongue lug and a crimp-on type spade lug. The spade lug allows connection to hot leads at the fuse block of the vehicle and the ring tongue lug permits attachment to screws of terminals. Determine from Table 1 which radio functions are to be switched through the vehicle ignition switch. A typical hookup

Table 1. Radio Functions Connections

Conductor	Green	Orange	Green	Orange	Green	Orange
Connected to battery	•	•	•			
Connected to ignition switch				•	Note 1	•
Ignition switch controls	No ignition switch control		Xmtr ignition switch controlled		Complete radio ignition switch controlled	
In any application, trim and strip wires. Crimp on ring lug for battery connections. For ignition switch connections, crimp on ring or spade lug (whichever is required).						

Note 1: In cases where alternator whine or other interference is a problem, the green lead can be isolated with a relay (Motorola part no. 59-813674).

provides for ignition switch control of the transmitter function only, thus permitting the receiver to operate whenever the radio set is turned on. In this case, the orange wire is connected to the accessory terminal of the ignition switch and the green wire is connected directly to the ungrounded terminal of the battery or starter solenoid.

CAUTION

Do NOT connect either lead to the ungrounded terminal of the battery at this time.

Step 8. If either wire is to be connected in the engine compartment, pass the lugless end of the wire through the same firewall hole that the red power cable uses, trim to length and crimp on the ring lug. If directed to a point within the passenger compartment, route cable to the point, leaving some extra length, and trim. Strip and crimp on either the spade or the ring tongue lug whichever is required. As an extra precaution the wire and lug may be soldered after crimping.

Step 9. Do not dress the wires at this time, but go to the next procedure.

6. RADIO INSTALLATION

(Refer to Figures 3 and 4.)

WARNING

For vehicles equipped with electronic anti-skid braking systems, refer to "Anti-Skid Braking Precautions", Motorola publication number 68P81109E34. This document is available free of charge.

Step 1. Choose a location where the mounting screws are not directly above the gas tank, gasoline, or other vital parts. The mounting tray of the radio set must be mounted permanently to a flat surface using four mounting holes or to an uneven surface using the alternate three point mounting. (The four point mounting is strongly recommended for installation in vehicles subject to extreme vibrations.) The raised shelf in some car trunk compartments makes a good mounting place. Place the radio at one side to allow space for luggage. Leave at least three inches in front of the radio set, so that the handle can be opened and the radio assembly can be removed from the mounting tray. The radio must be located so that the black ground lead in the trunk can reach a good chassis ground point in the trunk. When the final position is determined, unlock the radio, open the handle and lift the radio assembly away from the mounting tray (pull forward and upward to release the radio assembly). The mounting tray can be used as a template to mark the location for drilling the four mounting holes in the trunk floor. Use a #11 drill (.191"). Mount the mounting tray as illustrated in Figures 3 and 4.

Step 2. When the radio set is securely mounted to the trunk floor in some vehicles, the front panel will be pressing against the floor or floor cushioning. Also, in some vehicles where it is necessary to mount the radio set directly over the gas tank, the mounting screws may penetrate the tank (always make a preliminary check to see how far the screws will extend below the trunk floor). If either condition exists, insert one of the thick spacer washers between the bottom of the mounting tray and the thin spacer washer, at each of the four mounting holes. The washers help to keep the radio set level, especially when the floor is covered with a "spongy" mat such as soft rubber. Replace the radio assembly by sliding the radio onto the tray at about the halfway point. Push straight back until the tray tabs enter the two window areas on the radio front and engage the handle tabs. Close by pushing the handle until it locks. The handle locks the radio to the mounting tray and conceals the top cover release button. Push the multi-conductor plug onto the male connector and rotate the thumbscrew clockwise to fully seat the connector. Reverse the procedure for removing the radio.

Step 3. Connect the black ground cable lug to a convenient location on the trunk floor. Thoroughly clean the trunk floor surface before proceeding. Center punch and drill a 3/16" (.187") hole through the mounting surface. Use the supplied #14 x 3/4" self-tapping screw and 1/4" lockwasher to mount the cable lug.

CAUTION

A good ground connection of the black cable is essential for radio operation and to prevent damage to the radio and cable

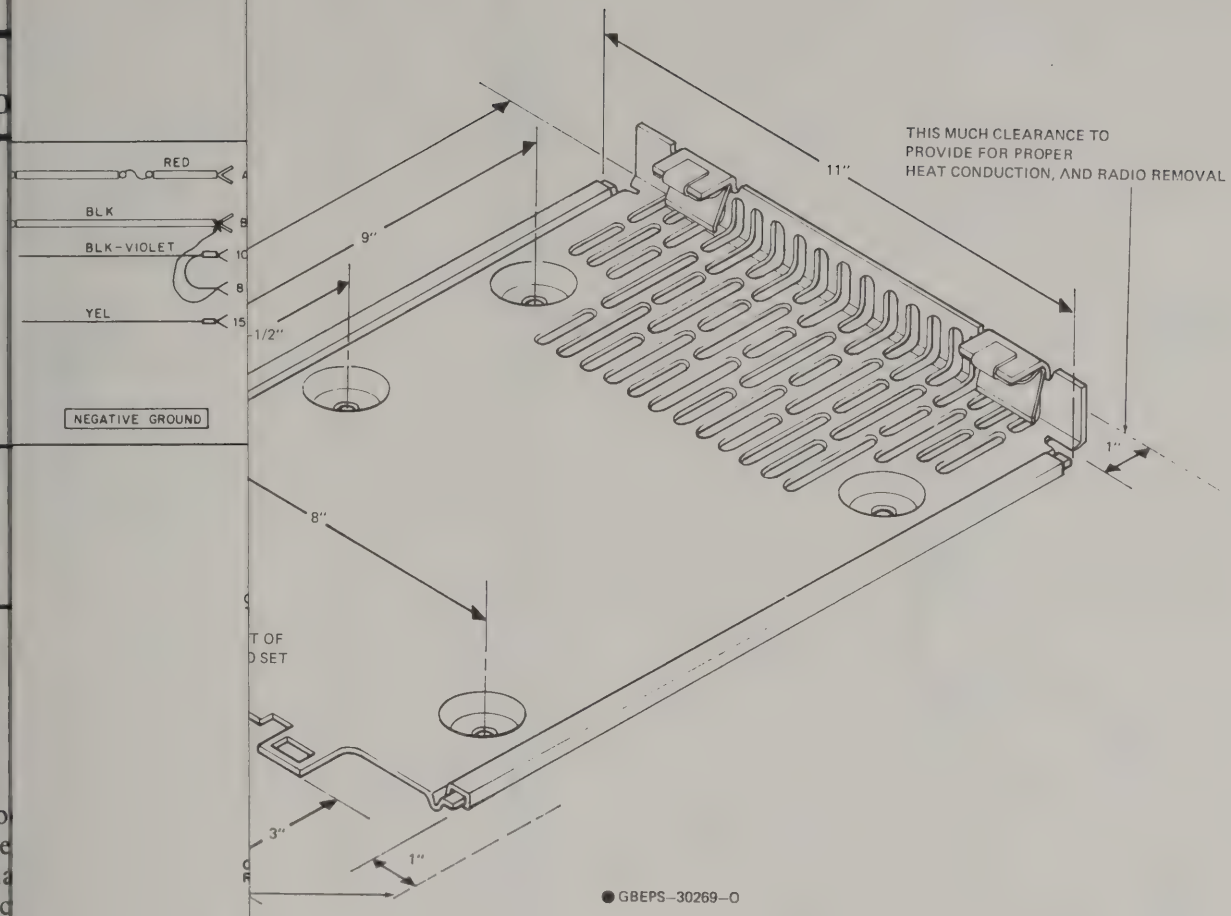


Figure 3. Mounting Tray

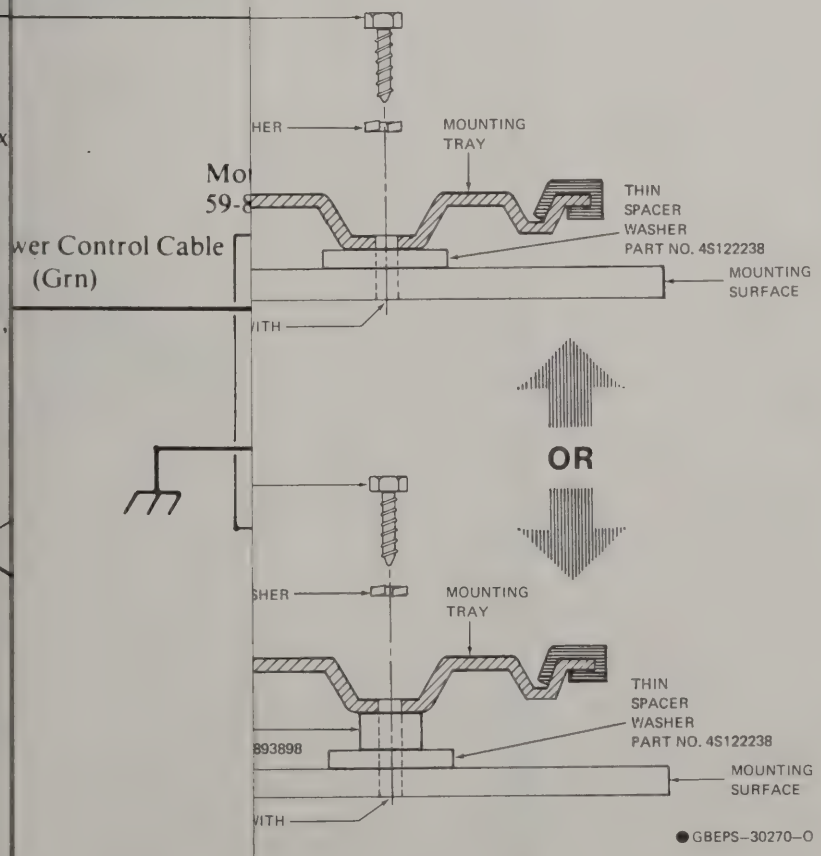


Figure 4. Mounting Tray Installation Detail

Table 1. Radio Functions Connections

Conductor	Green	Orange	Green	Orange	Green	Orange
Connected to battery	•	•	•			
Connected to ignition switch				•	Note 1	•
Ignition switch controls	No ignition switch control		Xmtr ignition switch controlled		Complete radio ignition switch controlled	
In any application, trim and strip wires. Crimp on ring lug for battery connections. For ignition switch connections, crimp on ring or spade lug (whichever is required).						

Note 1: In cases where alternator whine or other interference is a problem, the green lead can be isolated with a relay (Motorola part no. 59-813674).

provides for ignition switch control of the transmitter function only, thus permitting the receiver to operate whenever the radio set is turned on. In this case, the orange wire is connected to the accessory terminal of the ignition switch and the green wire is connected directly to the ungrounded terminal of the battery or starter solenoid.

CAUTION

Do NOT connect either lead to the ungrounded terminal of the battery at this time.

Step 8. If either wire is to be connected in the engine compartment, pass the lugless end of the wire through the same firewall hole that the red power cable uses, trim to length and crimp on the ring lug. If directed to a point within the passenger compartment, route cable to the point, leaving some extra length, and trim. Strip and crimp on either the spade or the ring tongue lug whichever is required. As an extra precaution the wire and lug may be soldered after crimping.

Step 9. Do not dress the wires at this time, but go to the next procedure.

6. RADIO INSTALLATION

(Refer to Figures 3 and 4.)

WARNING

For vehicles equipped with electronic anti-skid braking systems, refer to "Anti-Skid Braking Precautions", Motorola publication number 68P81109E34. This document is available free of charge.

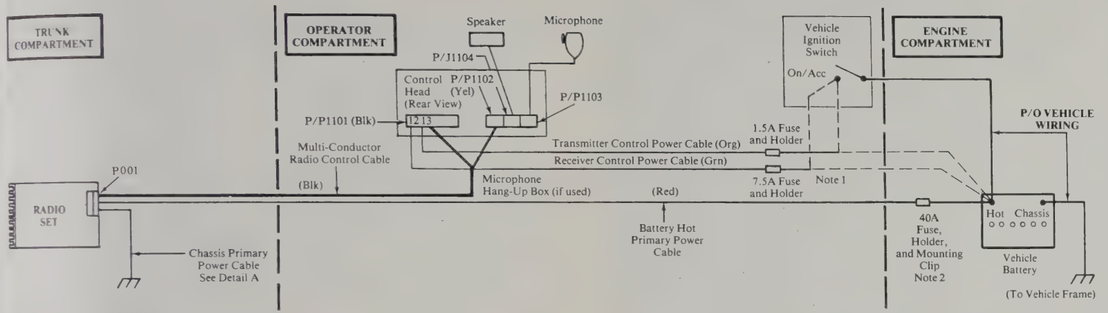
Step 1. Choose a location where the mounting screws are not directly above the gas tank, gasoline, or other vital parts. The mounting tray of the radio set must be mounted permanently to a flat surface using four mounting holes or to an uneven surface using the alternate three point mounting. (The four point mounting is strongly recommended for installation in vehicles subject to extreme vibrations.) The raised shelf in some car trunk compartments makes a good mounting place. Place the radio at one side to allow space for luggage. Leave at least three inches in front of the radio set, so that the handle can be opened and the radio assembly can be removed from the mounting tray. The radio must be located so that the black ground lead in the trunk can reach a good chassis ground point in the trunk. When the final position is determined, unlock the radio, open the handle and lift the radio assembly away from the mounting tray (pull forward and upward to release the radio assembly). The mounting tray can be used as a template to mark the location for drilling the four mounting holes in the trunk floor. Use a #11 drill (.191"). Mount the mounting tray as illustrated in Figures 3 and 4.

Step 2. When the radio set is securely mounted to the trunk floor in some vehicles, the front panel will be pressing against the floor or floor cushioning. Also, in some vehicles where it is necessary to mount the radio set directly over the gas tank, the mounting screws may penetrate the tank (always make a preliminary check to see how far the screws will extend below the trunk floor). If either condition exists, insert one of the thick spacer washers between the bottom of the mounting tray and the thin spacer washer, at each of the four mounting holes. The washers help to keep the radio set level, especially when the floor is covered with a "spongy" mat such as soft rubber. Replace the radio assembly by sliding the radio onto the tray at about the halfway point. Push straight back until the tray tabs enter the two window areas on the radio front and engage the handle tabs. Close by pushing the handle until it locks. The handle locks the radio to the mounting tray and conceals the top cover release button. Push the multi-conductor plug onto the male connector and rotate the thumbscrew clockwise to fully seat the connector. Reverse the procedure for removing the radio.

Step 3. Connect the black ground cable lug to a convenient location on the trunk floor. Thoroughly clean the trunk floor surface before proceeding. Center punch and drill a 3/16" (.187") hole through the mounting surface. Use the supplied #14 x 3/4" self-tapping screw and 1/4" lockwasher to mount the cable lug.

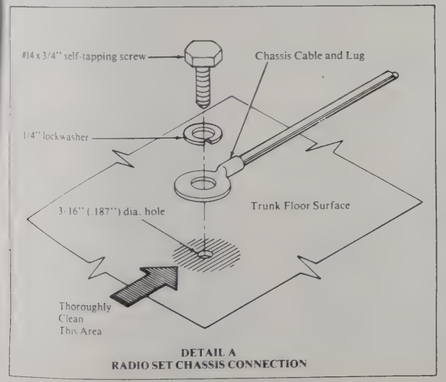
CAUTION

A good ground connection of the black cable is essential for radio operation and to prevent damage to the radio and cable

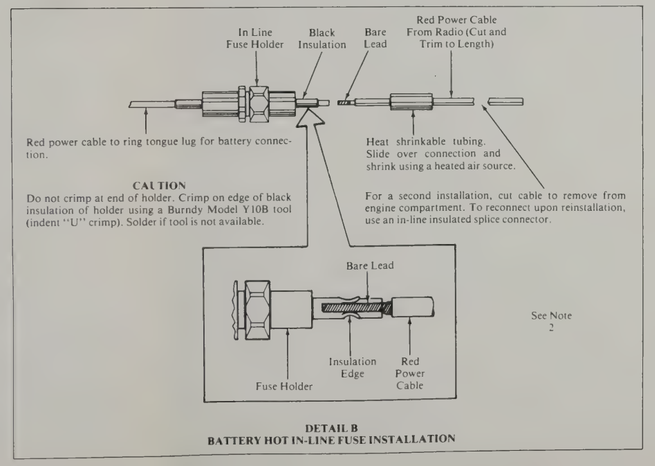


CAUTION

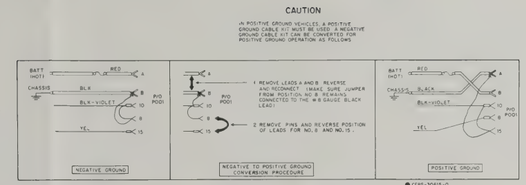
A good chassis connection via the black primary power cable is essential for radio operation and to prevent damage to the radio and cable kit. Connection to the vehicle frame is desirable.

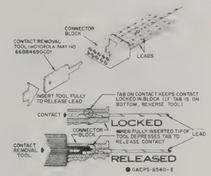


DETAIL A
RADIO SET CHASSIS CONNECTION



DETAIL B
BATTERY HOT IN-LINE FUSE INSTALLATION





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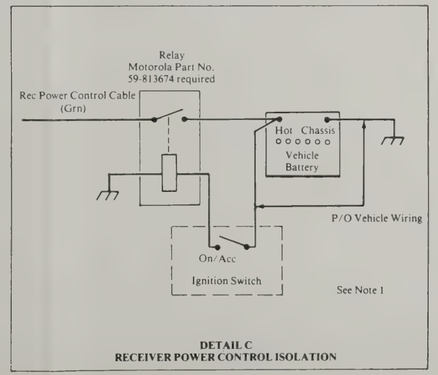

DETAIL C
RECEIVER POWER CONTROL ISOLATION

NOTES:

1. The transmitter power control cable (ORG) and the receiver power control cable (GRN) may be connected to the vehicle battery or to the ignition switch. The recommended configuration of these cables connects the receiver control cable (GRN) directly to the battery and the transmitter control cable to the ignition switch (at the ON/ACC terminal). In this configuration, the receiver is operable whenever the control head is turned on but the transmitter is operable only when the ignition switch is turned on (as well as the control head). If both cables are connected directly to the battery, the entire radio is operable (under control of the control head). If both cables are connected to the ignition switch, the radio is operable only when the ignition switch is turned on. In this configuration, alternator whine and other noise problems may occur in the receiver section. If this is the case, the receiver control cable may be isolated with a relay (Motorola number 59-813674 or equivalent) as shown in Detail C.

2. The radio battery hot primary power cable is supplied as two pieces, a red cable which is part of the radio control cable kit and another red cable with an in-line fuse on one end and a ring tongue lug on the other. After routing the radio power cable from the radio connector to the engine compartment, these cables are spliced as shown in Detail A. Refer to the cable routing procedure for further details.

Figure 2. Cable Routing Details

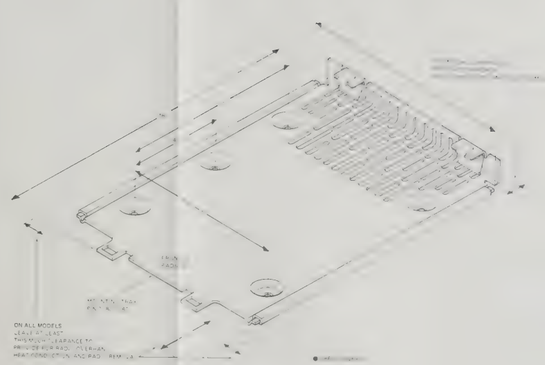

Figure 3. Mounting Tray

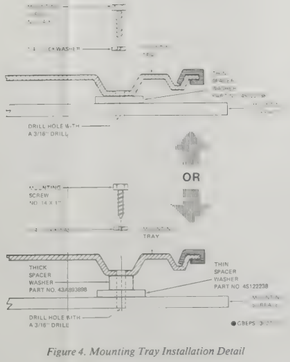

Figure 4. Mounting Tray Installation Detail

CAUTION (Cont'd.)

kit. Grounding to the vehicle frame is desirable. On some late-model automobiles the ground connection between the vehicle chassis and engine block is inadequate for good mobile radio operation. *DO NOT* compensate for this problem by connecting the radio set ground directly to the battery. Connect a flexible metal ground strap between the engine block and a vehicle chassis point common to the radio set ground. Be sure the strap is heavy enough to carry maximum transmitter supply current.

Step 4. All cables (including the antenna lead-in) should be dressed out of the way as much as possible to prevent damage and the radio heatsink should be placed to have the largest available supply of air possible for cooling.

7. CONTROL HEAD INSTALLATION

7.1 GENERAL

The control head must be installed within the reach of the operator. Pull more control cable into the area, if necessary. At this time, insert the female contacts from the green and orange fused wires into the proper position in the black connector housing. Be sure that all wires are clear of the instrument panel where holes are to be drilled.

7.2 INSTALLATION PROCEDURE

(Refer to Figure 5.)

Step 1. Determine the location for mounting the control head.

Step 2. Remove the trunnion bracket and retainer assembly from the control head by removing the two trunnion side screws.

CAUTION

Care must be taken in removing the trunnion bracket from the control head. After removing the side screws from the trunnion bracket, spread the bracket slightly to prevent damage to the circular friction action between the cup on the control head and the clutch facing on the bracket.

Step 3. Disassemble the retainer and breakaway disc assembly from the trunnion bracket by using a 5/16" nut driver to remove the #10-32 x 1/2" lockscrew.

Step 4. Remove the tapping screws and lockwashers from the control head retainer. Discard the paper retainers.

Step 5. Remove the backing from the self-adhesive mounting template and fasten the template at the location where the control head is to be mounted.

NOTE

This template locates the mounting holes for drilling and should be left in place to show the re-assembly of the trunnion bracket if the installation is changed at a later date.

Step 6. Center punch and drill two 0.157" (#22 drill) holes at the position located on the template.

Step 7. Mount the control head retainer and breakaway disc assembly with the supplied hardware (two #10 x 5/8" tapping screws and #10 lockwashers) using a 5/16" nut driver.

Step 8. Mount the trunnion bracket to the control head retainer assembly using the #10-32 x 1/2" lockscrew removed in Step 3.

NOTE

Before tightening the lockscrew, rotate the trunnion bracket to the desired horizontal position; then tighten the lockscrew.

Step 9. Insert the connector housings into the proper locations on the back of the control head. Now connect the control cable "S" hook to the proper hole in the cable strain relief bracket on the rear of the control head.

Step 10. Reassemble the control head to the trunnion bracket using caution as advised in Step 2.

NOTE

Before tightening the two trunnion side screws, rotate the control head into the desired vertical position.

8. MICROPHONE INSTALLATION

8.1 GENERAL

The microphone bracket must be within a comfortable arm's reach of the operator. Measure this distance before actually mounting the microphone bracket. Since the bracket has a positive detent action, the microphone can be mounted in almost any position. Mounting the bracket to the bottom of the control head will provide a break-away feature for the microphone also. After installation, connect the microphone plug to the receptacle on the control head. Make sure that the clip on the control head firmly engages the plug. Connect the microphone cable "S" hook to the proper hole in the strain relief clip on the rear of the control head.

8.2 INSTALLATION PROCEDURE
(Refer to Figure 6.)

Step 1. Remove the hangup clip from its taped position on the microphone.

Step 2. Remove the two paper retainers and screws from the clip.

Step 3. Determine the location for installation.

Step 4. Using the clip as a template, mark the location of the two mounting holes.

Step 5. Center punch and drill a 0.144" diameter hole at each location.

Step 6. Mount the clip securely using the supplied screws.

9. SPEAKER INSTALLATION

9.1 GENERAL

The speaker kit includes a trunnion bracket, hanger bracket, and wall mount bracket, which permits the speaker to be mounted in a variety of ways. The trunnion bracket provides a large variety of permanent mountings (dashboard and accessible firewall areas) for the speaker while permitting it to be tilted or angled for best results. The hanger bracket (already attached to the speaker) alone permits temporary mounting on projections such as automobile windows, etc. In this case, the trunnion bracket must be removed. The wall mount bracket can be used for permanent mountings if the trunnion bracket is too large to fit in some inaccessible areas. In this case, the trunnion bracket is removed and the speaker is attached to the wall mount bracket by the hanger bracket.

9.2 INSTALLATION USING TRUNNION BRACKET
(Refer to Figure 7.)

Step 1. Remove the trunnion bracket by loosening the two wing screws.

Step 2. Remove the three paper retainers and screws from the trunnion bracket.

Step 3. Remove the wall mount bracket from its taped position on the hanger bracket (retain for future use).

Step 4. Determine the location for installation. If space limitations require the removal of the hanger bracket, remove the Phillips head screw and slide the bracket out of the speaker housing (the speaker housing does not require disassembly to remove the hanger bracket).

Step 5. Using the trunnion bracket as a template, mark the location of the three desired mounting holes.

Step 6. Center punch and drill a 0.101" (#38 drill diameter hole at each location.

Step 7. Mount the trunnion bracket using the supplied screws.

Step 8. Remount the speaker into the trunnion bracket and tighten the two wing-screws.

Step 9. Plug the speaker lead into the control head making sure that the plug is solidly seated.

Step 10. Connect speaker cable "S" hook to hole in the strain relief clip on the bottom of the control head.

Step 11. Tie up surplus speaker lead cable.

9.3 INSTALLATION USING WALL MOUNT BRACKET
(Refer to Figure 7.)

Step 1. Remove the wall mount bracket from its taped position on the hanger bracket.

Step 2. Remove the trunnion bracket and trunnion wing-screws (retain for future use).

Step 3. Remove the two paper retainers and screws from the wall mount bracket.

Step 4. Determine the location for installation.

Step 5. Using the bracket as a template, mark the location for the screws.

Step 6. Center punch and drill a 0.101" (#38 drill) diameter hole at both locations.

Step 7. Mount the wall mount bracket to the surface with the supplied screws.

Step 8. Firmly seat the hanger bracket (attached to the speaker) in the wall mount bracket.

Step 9. Plug the speaker lead into the control head making sure that the plug is solidly seated.

Step 10. Connect speaker cable "S" hook to hole in strain relief clip on the bottom of the control head.

Step 11. Tie up surplus speaker lead cable.

10. POWER CONNECTIONS
(Refer to Figures 1 and 2.)

10.1 Replace the fuse in the in-line fuseholder of the red power cable coming from the radio in the trunk. Also connect the green (and/or orange) fused wire(s) coming from the control head to the ungrounded terminal (or source) of the battery.

10.2 Pull all excess cabling into the trunk. Clamp the cables to the vehicle body or chassis using the cable clamps supplied. To secure the clamps four tapping screws (#8-3/8") and four lockwashers (#1/4) are used. A 1/8" (0.125") hole is needed for the tapping screws. Make certain that all in-line fuses are installed.

11. ANTENNA INSTALLATION

(Refer to Figure 1.)

A diagram and complete installation instructions are supplied with each antenna ordered. Refer to these installation instructions for all information pertaining to the antenna.

12. CONCLUSION OF INSTALLATION

12.1 Make certain that the control head and mic PTT switches are off. Replace the 40A fuse in the red primary power cable in-line holder. Replace the 1.5A fuse in the orange cable in-line holder. Replace the 7.5A fuse in the green cable in-line holder.

10.2 Turn the radio on at the control head and verify proper operation of all controls and indicators. (Radio operation in some installations requires the turning on of the vehicle ignition. See Table 1.) Perform a complete operational check of the radio.

NOTE

If alternator or other noise is present in the received signal or in the transmission, refer to "Reducing Noise Interference in Mobile Two-Way Radio Installations", Motorola publication number 68P81109E33. This document is available free of charge.

10.3 Dress the control and power cables out of the way to prevent damage (pull any excess cable into the trunk area) and secure them with the supplied clamps and screws where necessary. Replace the rear seat if it had been removed in the cable routing procedure.

SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES

Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. *However, CMOS circuits can be damaged by improper handling of the modules even in a system.*

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

1. Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch *both* hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

NOTE

Wearing Conductive Wrist Strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

2. Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.

3. Normally, circuit modules can be inserted or removed with power applied to the unit. However, check the INSTALLATION and MAINTENANCE sections of the manual as well as the module schematic diagram to insure there are no objections to this practice.

4. When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

5. All electrically powered test equipment should be grounded. *Apply* the *ground lead* from the test equipment to the circuit module *before* connecting the *test probe*. Similarly, *disconnect* the *test probe prior* to removing the *ground lead.*

6. If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through 100k of resistance.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

7. When soldering, be sure the soldering iron is grounded.

8. Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

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9. When replacing a CMOS integrated circuit device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.

10. All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

11. Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a similar material (aluminum foil may be used). NEVER USE NON-CONDUCTIVE MATERIAL for packaging these modules.

TRUNKED SYNTOR X GENERAL MAINTENANCE/ TROUBLESHOOTING

1. RECOMMENDED TEST EQUIPMENT FOR TRUNKED SYNTOR X RADIO SERVICING

General Type	Application	Recommended Model	Minimum Specification
AC-DC VOM	DC voltage measurements, general	Motorola T1009A	Measurement range: 0-15 V dc Sensitivity: 20,000 ohms/volt
DC Multimeter	DC voltage readings requiring a high input resistance meter	Motorola S1063B	Measurement range: 0-15 V dc Input resistance: 11 megohms
AC Voltmeter	Audio voltage measurements	Motorola S1053C	Measurement range: 0-1 mV ac Input resistance: 1 megohm
RF Voltmeter	RF voltage measurements	Motorola S1339A	Measurement range: 100 uV-3 V from 1 MHz-900 MHz Inputs: 50 ohm and high impedance
Oscilloscope, Dual-Trace	Waveform observation	Motorola R1004A	Vertical sensitivity: 5 mV-10 V/division Horizontal time base: 0.2 usec.-0.5 sec/division
RF Wattmeter	Transmitter output power measurement	Motorola T1039 with appropriate element and T1013 RF Dummy Load	Measurement range: 0-50 watts
Frequency Meter	Transmitter frequency measurement	Model R1200 Service Monitor with high stability oscillator (X suffix) option. Frequency calibration recommended every 6 months or less.	Measurement range: 806-870 MHz Frequency resolution: 10 Hz
Deviation Meter	Transmitter modulation deviation measurement	Motorola R1200 Service Monitor with SLN6350 Deviation Meter.	Measurement range: 0-10 kHz deviation Frequency range: 806-870 MHz
RF Signal Generator	Receiver alignment and troubleshooting	Motorola R1200 Service Monitor with attenuator	Frequency range: 806-870 MHz Output Level: 0.1 uV-100,000 uV Must be capable of at least ±3 kHz deviation when modulated by 1 kHz tone.
Audio Signal Generator	Audio circuit troubleshooting	Motorola S1067B	Frequency range: 20 Hz-20 kHz Output level: 50 mV-1 V
■Double-Balanced Mixer	Receiver Front-End Adjustment	Mini-Circuits Laboratory Model ZAD-4	—
■Logic Probe	Check Various Digital Devices	Motorola RTL-4014	—
Radio Test Set	Meter readings at circuit metering points for alignment and troubleshooting	Motorola S1056 Portable Test Set with a TEK-37 or TEK-37A Test Set Adapter or a Motorola TEK-5 Meter Panel with a TEK-40 Cable.	
■Tuning Tool Kit	Receiver and transmitter alignment	Motorola TRN4513A	
■DC Power Supply	DC power for shop service	Motorola R1011AA	1-20 V dc 0-40A

NOTE

All the test equipment listed above, with the exception of those marked with (■), can be replaced with the Motorola R2001 System Analyzer.

CAUTION

In positive ground systems the case of the TEK-5 Meter Panel and portions of the S1056B Portable Test Set are hot with respect to the vehicle chassis due to the nature of the positive ground installations. Take necessary precautions that the test equipment does not contact the vehicle chassis.

2. RADIO ALIGNMENT AND ADJUSTMENTS

2.1 INTRODUCTION

The following four adjustments can be made to the Trunked SYNTOR X radio by entering the Deviation Set Routine discussed in section 2.2.

- reference oscillator frequency
- deviation
- compensation
- transmitter power

All adjustments can be performed through holes that are directly accessible on the rf board, as shown in Figure 1. Readjustment of the receiver is not recommended since the receiver is preadjusted at the factory to allow a wide passband for all frequencies within the 851 MHz to 870 MHz range.

2.2 DEVIATION SET ROUTINE

2.2.1 Introduction

In normal field operation, the microprocessor in the Trunked SYNTOR X radio controls the rf channel selection, transmitter key-up, and receiver muting functions. However, when the unit is on the bench for a tune-up and is out of its normal operating environment, the microprocessor will not key the PA or unmute the receiver, thus preventing the use of normal tune-up procedure. To solve this problem, a special test routine has been incorporated into the radio.

2.2.2 Initial Set-Up

By momentarily applying a short to the test pads indicated (the board is screened "short pads for 1 sec to test") on the solder side of the personality board, the radio will automatically come up into the test routine.

2.2.3 Channel Selection

Step 1. Apply power to the radio under test. Momentarily short the test pads together (as described above). A single 450 Hz beep will be heard from the speaker to indicate operation on F1, after which the receiver will unmute.

Step 2. Step the radio to the next channel by tapping the microphone PTT button (this is achieved by depressing the PTT button and releasing it within 200 milliseconds). Two beeps will be heard from the speaker to indicate F2, after which the receiver will unmute. This procedure can be repeated to step the receiver from F1 through F4 with the number of beeps indicating the F number.

2.2.4 Transmitter Alignment

2.2.4.1 Three transmit modes are used for various transmitter checks and adjustments:

- Silent carrier
- Subaudible connect tone plus voice — low speed mode
- High-speed ACK tone — high speed mode

2.2.4.2 Silent Carrier

On a given channel, when the microphone PTT button is depressed and held, the microprocessor will key the PA without data modulation, and the MIC audio will be enabled. In this mode, the transmitter frequency, hum and noise, and voice deviation can be checked and adjusted. When the PTT button is released, the PA will be dekeyed and the receiver will unmute.

2.2.4.3 Subaudible Connect Tone Plus Voice — Low Speed Mode

If the microphone PTT button is depressed and held again, the PA will be keyed with a 105.88 Hz subaudible tone modulation, and a pulsed 180 Hz tone will be heard at the speaker. This tone is known as talk prohibit. This step is used to adjust the maximum voice plus subaudible tone deviation.

- ±4 kHz deviation for voice
- ±1 kHz deviation for subaudible connect tone
- ±5 kHz deviation total.

When the PTT button is released, the PA will be dekeyed and the receiver will unmute.

2.2.4.4 High Speed ACK Tone

If the microphone PTT button is depressed and held for the third time, the PA will be keyed with an 1800 Hz tone modulation. The MIC audio will be disabled and a 450 Hz alert tone will sound twice. This sound is known as talk permit. This step is used to check high-speed data deviation. The deviation level should be ±2.75 kHz to 3.25 kHz.

NOTE

Repeated depression and release of the PTT button will cause the radio to step through the three modes described above.

NOTE

Refer to the List of Recommended Test Equipment provided in this section of the manual.

2.3 REFERENCE OSCILLATOR FREQUENCY

NOTE

The reference oscillator frequency adjustment should be performed before setting or checking the deviation adjustment.

Step 1. Place radio in test mode by momentarily shorting the two indicated test pads on the solder side of the personality board. The radio should unmute and a single 450 Hz beep should be heard. The radio will be on test mode channel 1. Refer to "System Test Parameters" sheet inside packing box.

Typical System Test Parameters

Test Mode	Rcvr. Freq.	Channel No.	Function
CH4	865937500	597	Control/Voice
CH3	865437500	577	Control/Voice
CH2	864937500	557	Control/Voice
CH1	864437500	537	Control/Voice
	863937500	517	Voice
	863437500	497	Voice
	862937500	477	Voice
	862437500	457	Voice
	861937500	437	Voice
	861437500	417	Voice
	852912500	76	Voice
	852812500	72	Voice
	852712500	68	Voice
	852612500	64	Voice
	852512500	60	Voice
	852412500	56	Voice
	852312500	52	Voice
	851912500	36	Voice
	851812500	32	Voice
	851712500	28	BSI/Voice

This sheet is included inside the packing box and shows the technician all the frequencies in the system and also indicates which are assigned as control and voice channels. Shown above is the method by which one can determine the test mode frequencies.

Step 2. Connect a dummy load to the radio antenna port.

Step 3. Using the portable test set, key the radio without modulation.

Step 4. Adjust the reference oscillator warp control U608 (see Figure 1) until proper indication is obtained on the frequency meter.

2.4 COMPENSATION

NOTE

This procedure sets the ratio of the transmit audio signal between the VCO and the reference oscillator, thus insuring flat modulation response. The compensation adjustment potentiometer (R516) is set at the factory and, normally, does not require readjustment. However, the compensation adjustment procedure should be used whenever any of the following conditions occur in a radio: (a) if the VCO reference oscillator or common circuits board is replaced, and (b) if the compensation potentiometer is replaced or inadvertently adjusted.

Step 1. Turn the deviation potentiometer (Figure 1) halfway in a clockwise direction.

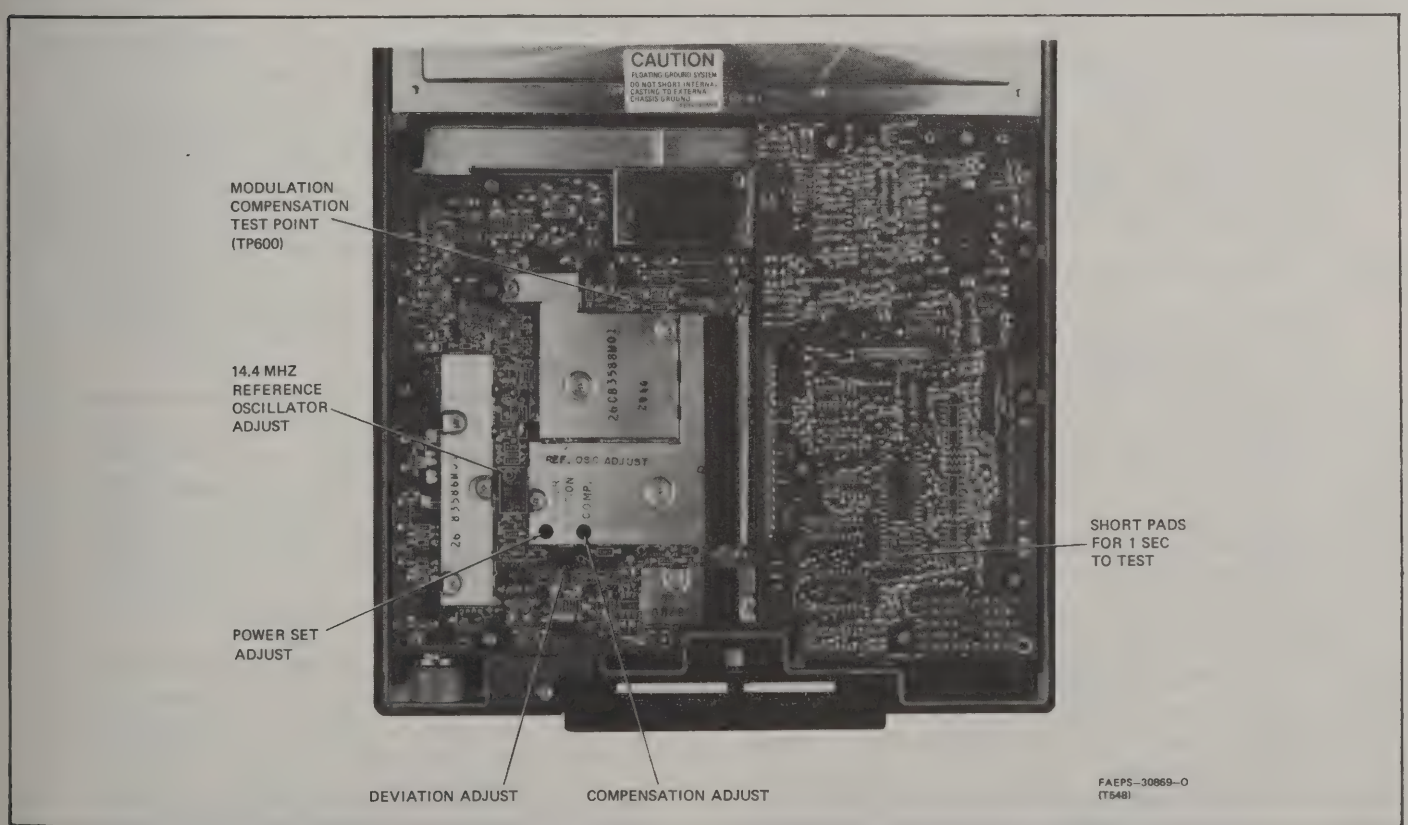


Figure 1. Radio Adjustments Locations

Step 2. With radio in test mode, key transmitter with microphone twice. Radio will be in low speed mode and transmitting 35-watt carrier modulated with 105.88 Hz low speed tone.

Step 3. Connect the center lead of the shielded cable of an ac voltmeter to the modulation compensation test point (Figure 1) and connect the shield to the radio ground (A-). Set the voltmeter to the 1 mV range.

Step 4. Adjust the compensation potentiometer until a null indication is obtained on the voltmeter. Cover the hole with a tape to prevent accidental adjustment of this control.

2.5 DEVIATION

NOTE

Because of the nature of the VCO, its modulation sensitivity tends to vary with the rf carrier band (standard or talk-around). Consequently, while setting deviation, it is important to check deviation on all transmit channels, especially if wide transmit separations (greater than 5 MHz) are required. This ensures that the radio will not over-deviate.

Step 1. Apply a 1 volt rms signal to microphone input and key radio in low speed mode.

Step 2. Adjust deviation for a total of ±5 kHz (1000 Hz tone + 105 Hz low speed tone).

2.6 TRANSMITTER POWER

Step 1. Terminate the radio with a wattmeter and 50-ohm load.

NOTE

Refer to the List of Recommended Test Equipment provided in this section of the manual. It is recommended that only the recommended equipment be used in these adjustments to avoid erroneous results.

Step 2. Adjust the dc power supply voltage to 13.6 V.

NOTE

Since the transmitter employs a broadband power amplifier, any channel may be selected for the power adjustment procedure.

Step 3. Place radio in test mode as described in section 2.2.2.

Step 4. Key up the transmitter and observe the output power indication. If the output power is greater than 15 W, go to Step 5; if the output power is less than 15 W, go to Step 6.

Step 5. Adjust the POWER SET potentiometer (Figure 1) for an output power indication of 38 W. A clockwise adjustment of this potentiometer (as viewed from the top of the radio) increases the output power, whereas a counterclockwise adjustment decreases the output power. If the initial output power is significantly greater than 38 W, it may suddenly drop during the course of this adjustment. If this condition occurs, go to Step 6.

Step 6. If the output power is less than 15 W, it is possible that the high drive protection circuit of the power control has been activated. Adjust the POWER SET potentiometer (Figure 1) in a counterclockwise direction until the output power drops to approximately 2 W. Rekey the transmitter and adjust the POWER SET potentiometer until an indication of 38 W is obtained.

3. RADIO DISASSEMBLY

3.1 GENERAL

3.1.1 The solder side of the rf board, personality board, and the power amplifier deck can be accessed from the top of the radio after removing the top cover. The top cover is removed by turning the key to release the front handle and then pushing the button under the handle. Once this is done, the top cover pops up, providing access to the boards. Access to the PA deck, however, requires the removal of the screw that holds the PA deck cover. This procedure provides access to the metering sockets of the rf board (J2501), of the personality board (J2), and of the PA deck (J1101) without removing the radio from its mounting tray.

3.1.2 The radio can be removed from the chassis by, first, releasing the handle, as described above. The radio can then be slid forward (about an inch) and lifted out. Disconnection of the cables allows removal of the radio from the chassis.

3.1.3 The rest of the radio can be accessed by removing the four screws that secure the skid plate to the bottom of the radio. Removal of the skid plate provides access to the metering socket of the common circuits board (J952). The common circuits board is hinged so that when turned on its hinge it provides access to its component side as well as to the component side of the rf board. To turn the common circuits board on its hinge requires the removal of two screws on the board as well as one additional screw on the regulator heat sink.

CAUTION

When operating the radio with the regulator heat sink screw removed, care should be taken to avoid the exposed hot flange.

CAUTION

All serviceable mounting screws use posidrive heads which can be damaged using standard Phillips screwdrivers. Posidrive tools are recommended. They are available through National Parts (Motorola Part Nos. 66-80344A57 and 66-80344A58).

NOTE

Mounting screws for the common circuits board, personality board, and rf board can be easily identified by the black plastic captivators that retain them to the boards.

3.2 COMMON CIRCUITS BOARD

To turn the common circuits board on its hinges requires the removal of three screws, but removal of the board from the radio also requires the removal of the two hinge screws. Moreover, the following should also be unplugged: (a) the ribbon cable between the common circuits board and the personality board, and (b) the wires between the common circuits board and the PA deck. While putting the common circuits board back into the radio, care should be taken to pass both the cable and the wires between the two board hinges.

3.3 PERSONALITY BOARD

The personality board can be removed from the radio by: (a) removing the seven screws that secure the board to the radio, (b) disconnecting the cable from the front plug, (c) disconnecting the ribbon cables from the common circuits board and filter board, and (d) pulling the board away from the radio to disconnect the connectors to the rf board. Placing the board back into the radio requires that care be taken to insure that the front plug gasket is properly seated. (Silicone compound, Motorola Part No. 1100834678, can be helpful in this process.)

3.4 RF BOARD

Removal of the rf board requires the following steps: (a) removal of the personality board, as explained above, (b) removal of the six retention screws, (c) disconnection of a coaxial cable between the rf board and the internal casting, and (d) disconnection of the wires located near the antenna switch. Access to some segments of the solder side of the rf board requires the removal of shields secured to the board by means of screws. On the component side of the rf board, two large cans can be removed by simply pulling them off the board; however, there are other cans which must be unsoldered to be removed. Placing the rf board back into the radio requires careful alignment between the board guide posts and the internal casting. Care must be taken to match the board spring connectors with those of the internal casting.

3.5 INTERNAL CASTING

3.5.1 General

Removal of the internal casting from the radio requires: (a) removal of three screws to allow the common circuits board to hinge, (b) removal of four cover mounting screws from the bottom of the radio, (c) removal of two screws from the rf board (from the other side of the radio), (d) disconnecting the cable between the internal casting and the rf board, (e) disconnecting the cable between the internal casting and the PA deck, and (f) disconnecting a set of rf board wires located near the antenna switch. During the reassembly operation, care should be exercised to make the proper connections between the various connectors and to replace all the screws without omission.

3.5.2 First Mixer

To remove the first mixer: (a) remove the two screws that secure the first mixer cover and gasket to the internal casting, (b) carefully unsolder the two tap leads from the first mixer to the filter, (c) remove solder between the feedthrough and the circuit board, and (d) remove the two screws that hold the circuit board to the internal casting. Now the first mixer board can be removed.

CAUTION

Do not use excessive heat. Otherwise the tap leads will come off the filter.

3.5.3 Preamplifier

Once the cover is removed, the preamplifier can be removed as follows: (a) carefully (and without using too much heat) unsolder and remove the tap lead from the two-pole filter, (b) unsolder and disconnect the preamplifier coaxial cable, and (c) disconnect the two isulated wires from the smaller preamplifier substrate (refer to the CAUTION below).

CAUTION

Refer to the special repair procedures provided in paragraph 4 which explains the techniques to be used while using the soldering iron on the hybrid substrates. It is imperative that solder with high silver content be used while removing the two insulated wires from the smaller preamplifier substrate. Since the smaller substrate is not copper clad, leaching of the pads can become a problem.

Remove the two screws that hold the carrier to the casting. Now it can be lifted out, using the handle that forms part of the carrier.

3.5.4 VCO Assembly

The VCO assembly is removed as fol lows: (a) remove the four screws that secure the VCO assembly cover, (b) disconnect the coaxial cable from the substrate, (c) disconnect the single insulated wire from the feedthrough. (Refer to the CAUTION presented above which deals with substrate soldering.) Now the VCO assembly can be removed by lifting and disconnecting it from the 7-pin connector.

NOTE

If the VCO assembly is replaced, it will be necessary to readjust the compensation level, as explained in the Radio Adjustment Procedures presented in the General Maintenance section of this manual.

3.5.5 VCO Buffer/Doubler

The VCO buffer/doubler is removed as follows: (a) disconnect the coaxial cable to the VCO, (b) disconnect the single wire to the feedthrough, (c) disconnect the coaxial cable to the rf board, and (d) disconnect the coaxial cable to the PA deck. (The coaxial cables are, first, removed from the substrate, using the precautions explained in paragraph 4. Then both cables are removed from the internal casting. This may require the use of a larger soldering iron to heat the internal casting. However, the larger soldering iron should NEVER be used on the substrate.) After removing the four mounting screws, the VCO buffer/doubler assembly can be removed by lifting the handle (the handle forms part of the carrier). Lifting the carrier will simultaneously disengage the connector to the three-pole injection filter. This filter is directly located under the carrier.

3.6 TRANSMITTER PA DECK

Disassembly of the transmitter PA deck should be done on a module basis. It is strongly recommended that the entire module be replaced whenever it is found to be faulty. Removal of the hybrid modules requires removal of: (a) the horseshoe-shaped connector straps between the modules, (b) the hold-down screws and (c) the A+ and A- leads. Refer to paragraph 4 whenever the horseshoe-shaped connector straps have to be replaced. Special care must be exercised not to fill the loop with solder since this would render the thermal expansion properties of the strap inoperative.

3.7 FRONT LATCH

The front latch key mechanism can be removed by inserting the key into the lock, turning the key about 45° in a clockwise direction, and inserting the special removal tool (Motorola Part No. 66-84909B01). This tool is inserted with the point directed away from the lock and twisting it 180° in a clockwise direction. This releases the key mechanism, which can then be removed. Removal of the black plastic part requires the removal of a single screw.

3.8 ANTENNA RELAY

The antenna relay can be removed by disconnecting: (a) the wires to the coil and, (b) the connector on the rf board. The coaxial cable to the internal casting can be unplugged at the casting, but the cable to the transmitter PA deck must be unsoldered at the harmonic filter. The antenna relay is secured by means of a nut located outside the radio chassis. Removal of this nut requires the use of a spanner nut removal tool (Motorola Part No. RSX4028A).

4. SPECIAL REPAIR PROCEDURES

4.1 MICROSTRIP CERAMIC SUBSTRATES

4.1.1 Repair of the Trunked SYNTOR X microstrip ceramic substrates is not recommended and, hence, should be avoided. Because of the critical nature of the 800 MHz circuits, the repair procedure should consist of replacing a faulty module rather than attempting to replace a faulty component on a given module. The Trunked SYNTOR X modules are built and tested at the factory, employing special fixture to insure proper functioning of these modules.

4.1.2 Soldering to microstrip ceramic modules should be done with as little heat or pressure as is practical. The Trunked SYNTOR X ceramic materials have properties that are similar to those of glass, i.e., they can be damaged by sharp blows or excessive heat. Solder with high percentage of silver should be used, to avoid leaching the capacitors or non-copper runners.

4.2 CHIP CAPACITORS

4.2.1 The Trunked SYNTOR X radio employs many chip capacitors as circuit elements. These capacitors are extremely sensitive to heat and must not be reused. Repairs to circuits near these components should be performed with care; heat, as from a soldering iron on a nearby component, may cause the capacitor end metalization (terminals) to "leach". Refer to Figure 2 for an example of a leached capacitor.

4.2.2 Chip capacitors must be removed by applying heat to both connecting terminals simultaneously and lifting when the connecting solder melts. This may be accomplished with two soldering irons or with a single iron using a special tip (Motorola part no. ST-1160). Refer to Figures 3 and 4 for examples of this removal technique.

4.2.3 When replacing chip capacitors, first apply a small amount of solder to the connection points on the circuit board. Place the capacitor at the desired location and attach it by heating the solder previously applied until it just melts. The soldering iron must ***never*** be applied directly to the capacitor.

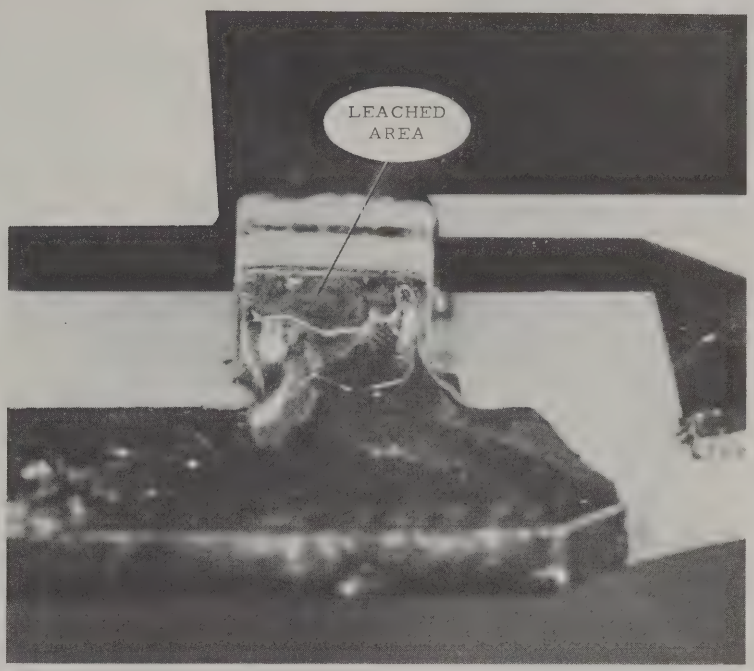


Figure 2.
Example of "Leached" Chip Capacitor

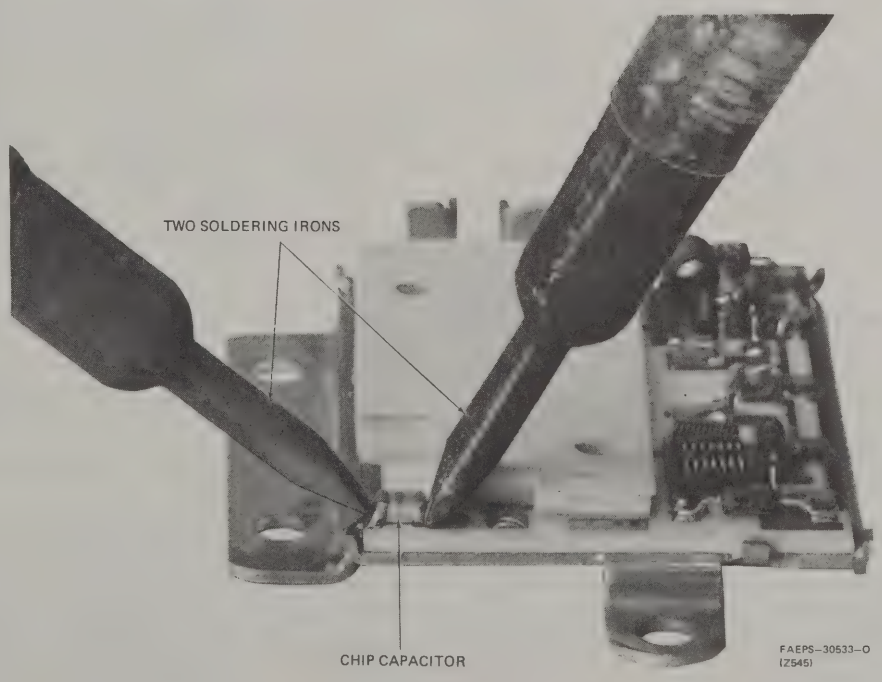


Figure 3.
Removal of Chip Capacitors With Two Soldering Irons

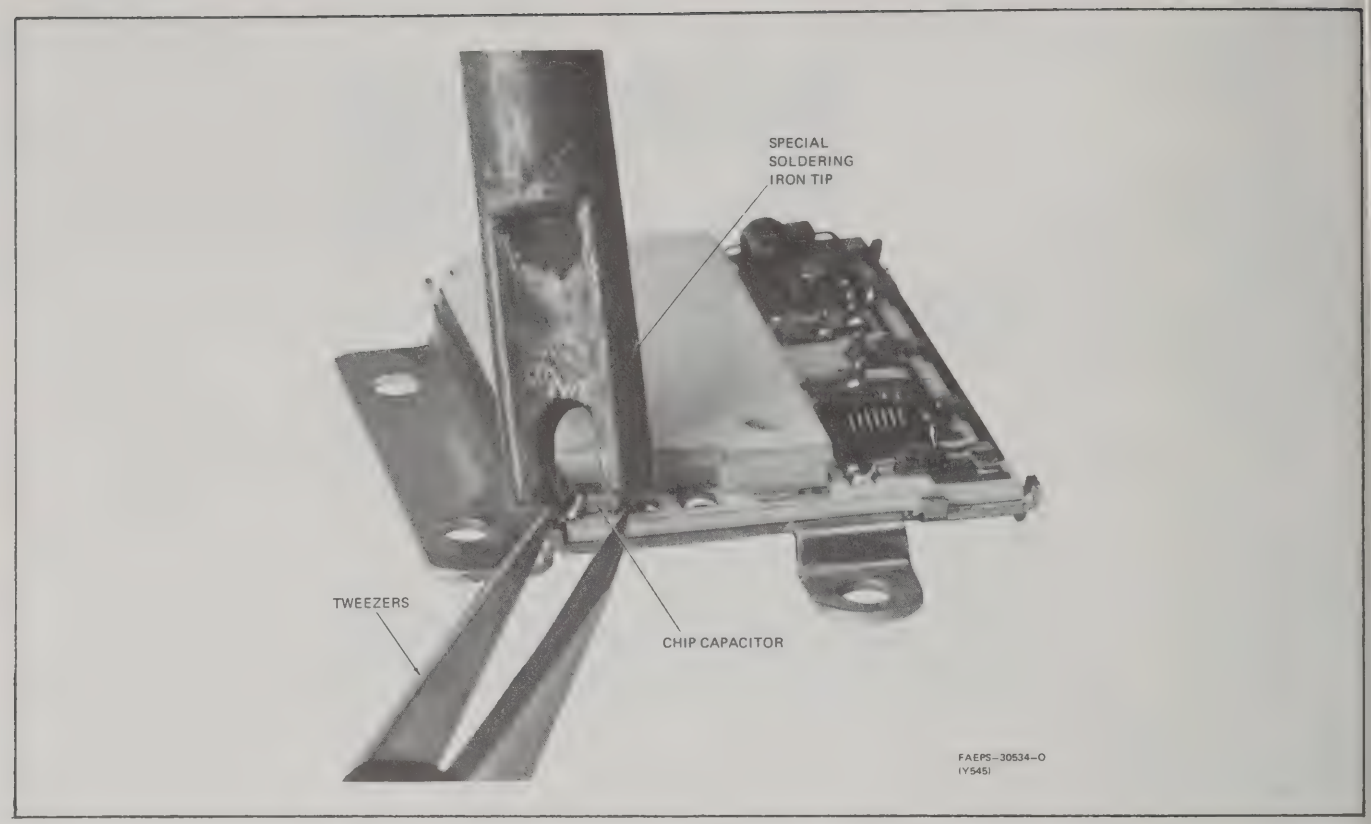


Figure 4.
Removal of Chip Capacitor With
Special Soldering Iron Tip

4.3 RF POWER AMPLIFIER

4.3.1 Removal

The predriver, driver, and final amplifier microstrips can be removed as explained below:

Step 1. Carefully unsolder the power supply bus bar leads from the microstrip.

CAUTION

Excessive heat during this operation can cause the microstrip solder lugs to become loose.

Step 2. Carefully unsolder and remove the foil bridges between the microstrip to be removed and the adjacent microstrip.

Step 3. Remove the screws attaching the transistor to the PA heatsink and then remove the microstrip and its carrier assembly.

4.3.2 Replacement

Use the following procedure to replace the predriver, driver, or final amplifier microstrip:

Step 1. Carefully apply Wakefield Thermal Compound (Motorola Part No. 11-83166A01) to the mounting surface (bottom side) of the transistor.

CAUTION

Application of thick coating of the thermal compound or the presence of foreign material on the transistor mounting surface may cause poor thermal contact and hence may result in early failure of the transistor.

Step 2. Place the microstrip assembly on the heatsink; turn (but do not tighten) the transistor mounting screws; align the microstrip with the adjacent microstrip(s); tighten the transistor mounting screws, insuring that proper alignment is maintained.

Step 3. Reconnect the power supply bus bar leads and install the foil bridges between the microstrip pads and those of the adjacent microstrip(s).

5. GENERAL SYSTEM TROUBLESHOOTING GUIDE

5.1 A general system troubleshooting guide is provided in the table shown below. This table is divided into three sections: symptoms of malfunction, possible cause of failure, and the procedure to be adopted to clear the fault. The failure symptoms deal with the following conditions: absence of receive audio, distorted receive audio, low audio power, no regulated 9.6 V or 5.0 V, no rf power output, low rf power output, no transmitter modulation, distorted transmitter modulation, improper microphone sensitivity, transmitter frequency shift with high-level modulation, synthesizer does not lock, reference frequency (6.25 kHz) heard in speaker or on transmitted audio, synthesizer locks on wrong frequency, slow synthesizer lock time, poor receive sensitivity, alternator whine.

5.2 Depending on the cause of failure, the following troubleshooting charts and schematic diagrams are referred to for consultation:

- Schematic diagram of the audio section of the personality board; this diagram provides various voltage levels and waveforms and is located in the Microcomputer System section of this manual.
- Regulator troubleshooting chart; this is located in the Common Circuits Board section of this manual.
- Synthesizer troubleshooting chart; this is located in the Synthesizer section of this manual.
- Power control troubleshooting chart; this is located in the Common Circuits Board section.
- Power amplifier troubleshooting chart; this is located in the Transmitter section.
- IDC troubleshooting chart; this is located in the Synthesizer section.
- Radio alignment and adjustment procedures; this is located in the General Maintenance section.

General System Troubleshooting Guide

Symptom	Possible Source of Trouble	Chart or Diagram To Be Referred To
No Receive Audio	Red or green lead fuse	Check the fuses
	Audio PA malfunction	Voltages and waveforms on audio schematic diagram (EEPS-30117)
	Regulator malfunction	Regulator troubleshooting chart (DEPS-30327)
	Synthesizer not locking	Synthesizer troubleshooting chart (EEPS-31423)
No Receive Audio	Quad detector malfunction	Receiver section schematic diagram
Distorted Receive Audio	Audio PA malfunction	Audio schematic diagram for voltages and waveforms
	Quad detector malfunction	Receiver section schematic diagram
	I-F malfunction	Receiver section schematic diagram
Low Audio Power	Audio PA malfunction	Audio schematic diagram
	Red lead fuse	Check fuse
	Quad detector malfunction	Receiver section schematic diagram
	I-F malfunction	Receiver section schematic diagram
No High Speed or Low Speed Data Encode	IDC malfunction	IDC portion of synthesizer troubleshooting chart
	Trunked filter board	Troubleshooting chart (CEPS-30989)
No Regulated 9.6 V or 5.0 V	Short on printed circuit board	—
	Regulator malfunction	Regulator troubleshooting chart
No RF Power Output	PA enable switch	Microcomputer schematic diagram
	Keyed 9.4 switch	Microcomputer schematic diagram
	Synthesizer out-of-lock	Synthesizer troubleshooting chart
	Red or orange lead fuse	Check fuses
	Power control malfunction	Power control troubleshooting chart (EEPS-30120)
	PTT circuit malfunction	Troubleshooting serial data link and control head. Refer to control head troubleshooting chart (EEPS-30821).
	PA malfunction	PA troubleshooting chart (EEPS-30266)
No Power Control	Power control malfunction	Power control troubleshooting chart
Low RF Power Output	Power control malfunction	Power control troubleshooting chart
	PA malfunction	PA troubleshooting chart
	Antenna relay malfunction	Antenna relay test procedure
No Transmitter Modulation	IDC malfunction	IDC portion of the synthesizer troubleshooting chart
	Power control malfunction	IDC portion of synthesizer troubleshooting chart
	Microcomputer malfunction	Microcomputer schematic

General System Troubleshooting Guide (Cont'd.)

Symptom	Possible Source of Trouble	Chart or Diagram To Be Referred To
Distorted Transmitter Modulation	IDC malfunction	IDC portion of synthesizer troubleshooting chart
	Reference oscillator malfunction	IDC portion of synthesizer troubleshooting chart
	VCO malfunction	IDC portion of synthesizer troubleshooting chart
Improper Microphone Sensitivity	IDC malfunction	IDC portion of synthesizer troubleshooting chart
	VCO malfunction	
	Reference oscillator malfunction	
Transmitter Frequency Shift with High-Level Modulation	IDC malfunction	IDC portion of synthesizer troubleshooting chart
Synthesizer Does Not Lock	Is radio scanning?	Out-of-lock LED will light if radio is scanning
	Synthesizer malfunction	Synthesizer troubleshooting chart
	Microcomputer malfunction	Microcomputer schematic
Reference frequency (6.25 kHz) heard in speaker or on transmitted audio	Adaptive filter malfunction	Synthesizer troubleshooting procedure
Synthesizer locks on wrong frequency	Synthesizer malfunction	Synthesizer troubleshooting chart
	Microcomputer malfunction	
	Reference oscillator out-of-adjustment	
Long synthesizer lock time	Synthesizer malfunction	Synthesizer troubleshooting chart
	VCO malfunction	
Poor receive sensitivity	High I-F malfunction	Receiver troubleshooting chart (EEPS-30325). Also refer to receiver section schematic diagram
	Low I-F malfunction	
	Quad detector malfunction	
	Preamplifier malfunction	
	First mixer malfunction	
	Second mixer malfunction	
	Antenna relay malfunction	Antenna relay test procedure
	Front-end alignment	Receiver front-end alignment
	IMPORTANT NOTE It is strongly advised that this front-end alignment procedure be avoided in the field. Consequently, it should be performed only as a last-resort measure.	
Alternator Whine	Chassis to A- short	Disconnect control cable and check for a short between chassis and A-.
	Excessive whine in vehicle	Refer to manual no. 68P81116A74

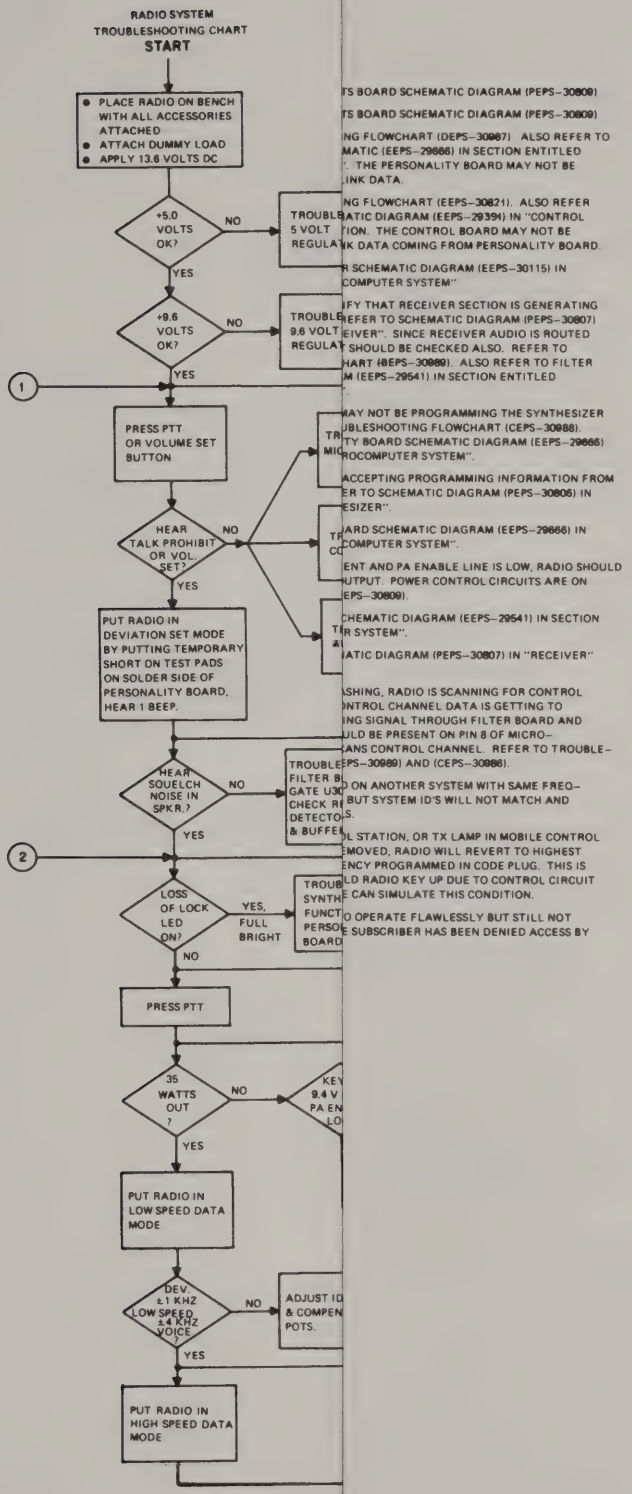
6. RADIO SYSTEM TROUBLESHOOTING CHARTS

A series of radio system troubleshooting charts follow. The areas covered are:

- Radio System
- Control Head
- Trunked Personality Board Serial Link Section
- Trunked Filter Board
- Trunked Personality Board Synthesizer Section
- Center Slicer

These troubleshooting charts are in addition to the charts and schematic diagrams located in other sections of this manual as referenced previously in section 5.

A radio set functional block diagram and exploded view with parts list are also included as troubleshooting aids.



Radio System Troubleshooting Chart
Motorola No. ***DEPS-30984-A***
1/15/81-PHI

General System Troubleshooting Guide (Cont'd.)

Symptom	Possible Source of Trouble	Chart or Diagram To Be Referred To
Distorted Transmitter Modulation	IDC malfunction	IDC portion of synthesizer troubleshooting chart
	Reference oscillator malfunction	IDC portion of synthesizer troubleshooting chart
	VCO malfunction	IDC portion of synthesizer troubleshooting chart
Improper Microphone Sensitivity	IDC malfunction	IDC portion of synthesizer troubleshooting chart
	VCO malfunction	
	Reference oscillator malfunction	
Transmitter Frequency Shift with High-Level Modulation	IDC malfunction	IDC portion of synthesizer troubleshooting chart
Synthesizer Does Not Lock	Is radio scanning?	Out-of-lock LED will light if radio is scanning
	Synthesizer malfunction	Synthesizer troubleshooting chart
	Microcomputer malfunction	Microcomputer schematic
Reference frequency (6.25 kHz) heard in speaker or on transmitted audio	Adaptive filter malfunction	Synthesizer troubleshooting procedure
Synthesizer locks on wrong frequency	Synthesizer malfunction	Synthesizer troubleshooting chart
	Microcomputer malfunction	
	Reference oscillator out-of-adjustment	
Long synthesizer lock time	Synthesizer malfunction	Synthesizer troubleshooting chart
	VCO malfunction	
Poor receive sensitivity	High I-F malfunction	Receiver troubleshooting chart (EEPS-30325). Also refer to receiver section schematic diagram
	Low I-F malfunction	
	Quad detector malfunction	
	Preamplifier malfunction	
	First mixer malfunction	
	Second mixer malfunction	
	Antenna relay malfunction	Antenna relay test procedure
	Front-end alignment	Receiver front-end alignment
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Alternator Whine	Chassis to A- short	Disconnect control cable and check for a short between chassis and A-.
	Excessive whine in vehicle	Refer to manual no. 68P81116A74

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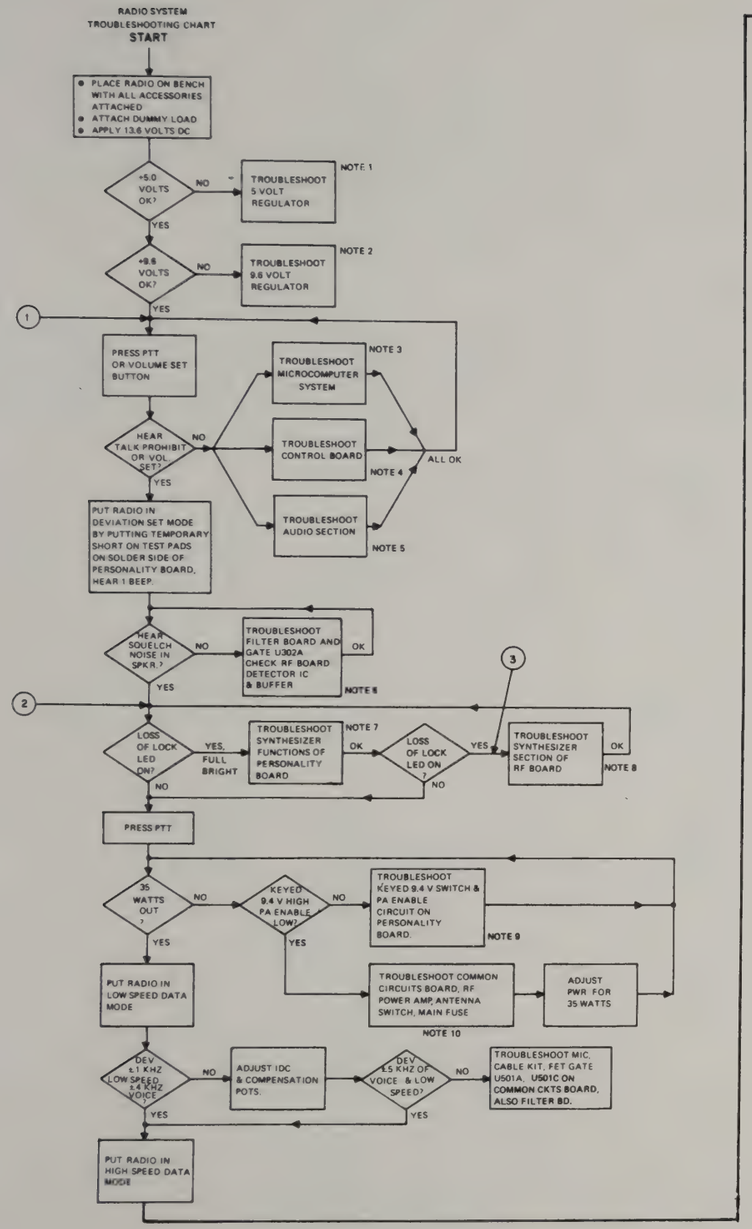


LEGEND:

(1) REFERS TO REFERENCE POINT ON CONTROL HEAD TROUBLESHOOTING CHART, MOTOROLA NO. EEPS–30821 AND PERSONALITY BOARD SERIAL LINK TROUBLESHOOTING CHART, MOTOROLA NO. DEPS–30987.

(2) REFERS TO REFERENCE POINT ON TRUNKED FILTER BOARD TROUBLESHOOTING CHART MOTOROLA NO. CEPS–30989.

(3) REFERS TO REFERENCE POINT ON TRUNKED PERSONALITY BOARD SYNTHESIZER SECTION TROUBLESHOOTING CHART MOTOROLA NO. CEPS–30988.

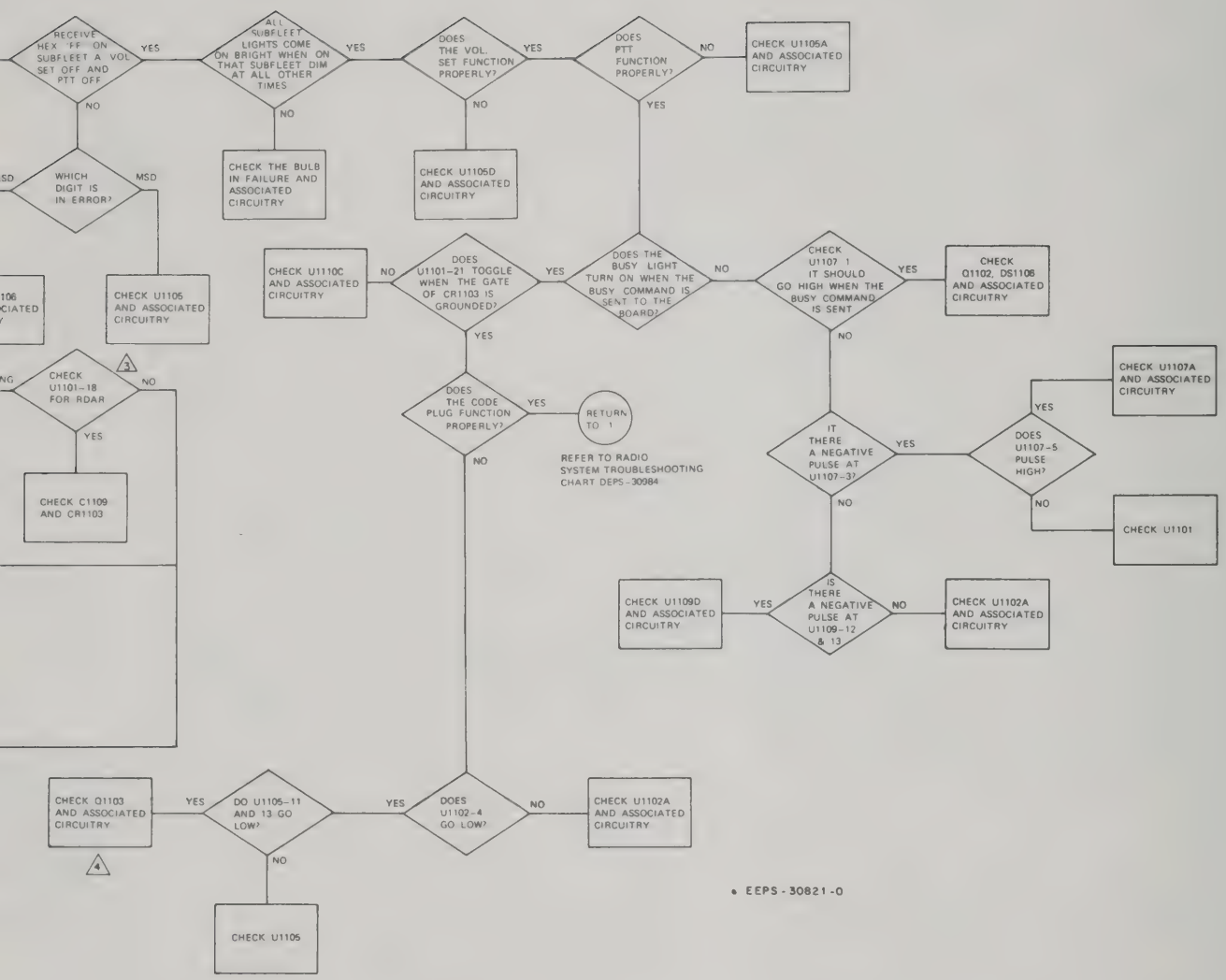
(4) REFERS TO REFERENCE POINT ON CENTER SLICER TROUBLESHOOTING CHART MOTOROLA NO. CEPS–30986.

DEPS–30984–A

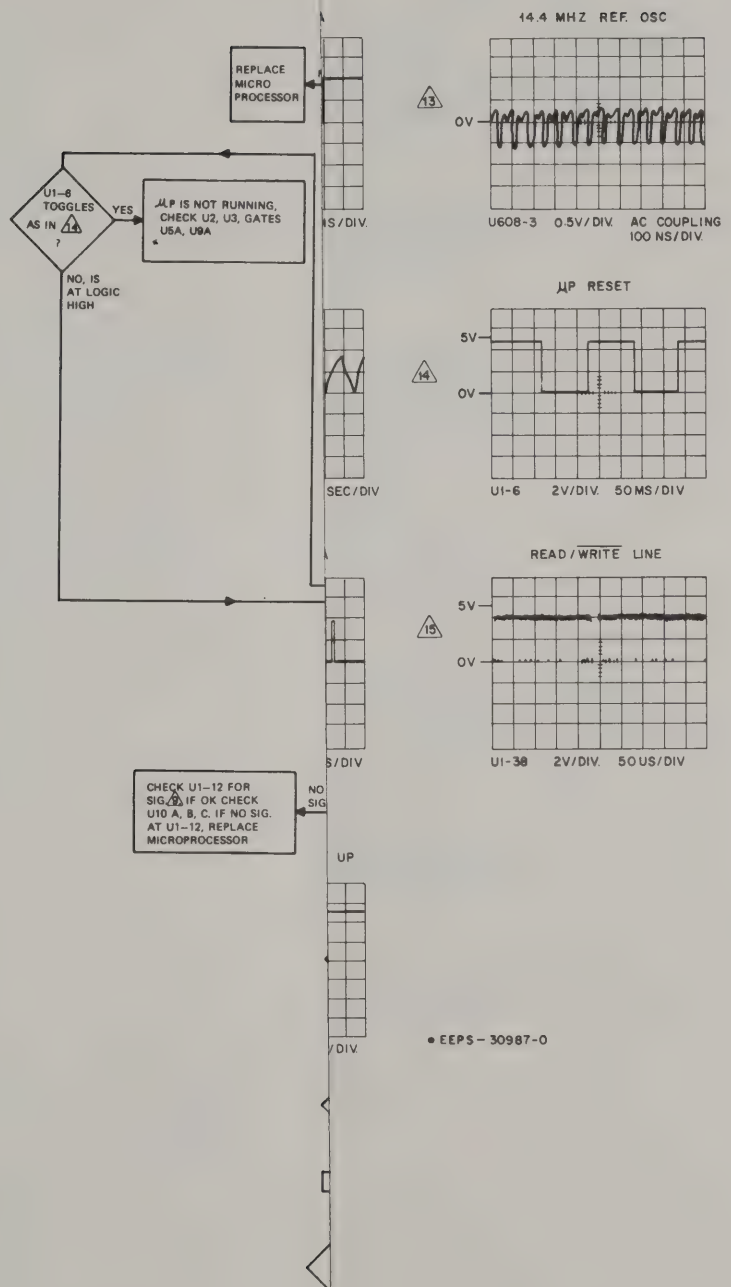
NOTES

1. REFER TO COMMON CIRCUITS BOARD SCHEMATIC DIAGRAM (PEPS–30809)
2. REFER TO COMMON CIRCUITS BOARD SCHEMATIC DIAGRAM (PEPS–30809)
3. REFER TO TROUBLESHOOTING FLOWCHART (DEPS–30987). ALSO REFER TO PERSONALITY BOARD SCHEMATIC (EEPS–29666) IN SECTION ENTITLED "MICROCOMPUTER SYSTEM". THE PERSONALITY BOARD MAY NOT BE GENERATING ANY SERIAL LINK DATA.
4. REFER TO TROUBLESHOOTING FLOWCHART (EEPS–30821). ALSO REFER TO CONTROL BOARD SCHEMATIC DIAGRAM (EEPS–2939H) IN "CONTROL BOARD AND CABLING" SECTION. THE CONTROL BOARD MAY NOT BE RESPONDING TO SERIAL LINK DATA COMING FROM PERSONALITY BOARD
5. REFER TO AUDIO AMPLIFIER SCHEMATIC DIAGRAM (EEPS–30115) IN SECTION ENTITLED "MICROCOMPUTER SYSTEM"
6. IF NO NOISE IS HEARD, VERIFY THAT RECEIVER SECTION IS GENERATING NORMAL SQUELCH NOISE. REFER TO SCHEMATIC DIAGRAM (PEPS–30807) IN SECTION ENTITLED "RECEIVER". SINCE RECEIVER AUDIO IS ROUTED THROUGH FILTER BOARD IT SHOULD BE CHECKED ALSO. REFER TO TROUBLESHOOTING FLOWCHART (BEPS–30989). ALSO REFER TO FILTER BOARD SCHEMATIC DIAGRAM (EEPS–29541) IN SECTION ENTITLED "MICROCOMPUTER SYSTEM".
7. THE PERSONALITY BOARD MAY NOT BE PROGRAMMING THE SYNTHESIZER PROPERLY. REFER TO TROUBLESHOOTING FLOWCHART (CEPS–30988). ALSO REFER TO PERSONALITY BOARD SCHEMATIC DIAGRAM (EEPS–29666) IN SECTION ENTITLED "MICROCOMPUTER SYSTEM"
8. SYNTHESIZER MAY NOT BE ACCEPTING PROGRAMMING INFORMATION FROM PERSONALITY BOARD. REFER TO SCHEMATIC DIAGRAM (PEPS–30805) IN SECTION ENTITLED "SYNTHESIZER".
9. REFER TO PERSONALITY BOARD SCHEMATIC DIAGRAM (EEPS–29666) IN SECTION ENTITLED "MICROCOMPUTER SYSTEM"
10. IF KEYED 9.4 VOLTS IS PRESENT AND PA ENABLE LINE IS LOW, RADIO SHOULD GENERATE RATED POWER OUTPUT. POWER CONTROL CIRCUITS ARE ON COMMON CIRCUIT BOARD (PEPS–30809)
11. REFER TO FILTER BOARD SCHEMATIC DIAGRAM (EEPS–29541) IN SECTION ENTITLED "MICROCOMPUTER SYSTEM"
12. REFER TO RECEIVER SCHEMATIC DIAGRAM (PEPS–30807) IN "RECEIVER" SECTION.
13. IF LOSS OF LOCK LED IS FLASHING, RADIO IS SCANNING FOR CONTROL CHANNEL. VERIFY THAT CONTROL CHANNEL DATA IS GETTING TO MICROPROCESSOR BY TRACING SIGNAL THROUGH FILTER BOARD AND CENTER SLICER. DATA SHOULD BE PRESENT ON PIN 8 OF MICRO–PROCESSOR WHEN RADIO SCANS CONTROL CHANNEL. REFER TO TROUBLE–SHOOTING FLOWCHARTS (BEPS–30989) AND (CEPS–30986)
14. MOBILE COULD BE LICENSED ON ANOTHER SYSTEM WITH SAME FREQ–UENCIES AS LOCAL SYSTEM, BUT SYSTEM ID'S WILL NOT MATCH AND RADIO CAN NOT MAKE CALLS.
15. IF RED TX LAMP ON CONTROL STATION, OR TX LAMP IN MOBILE CONTROL HEAD IS BURNED OUT OR REMOVED, RADIO WILL REVERT TO HIGHEST CONTROL CHANNEL FREQUENCY PROGRAMMED IN CODE PLUG. THIS IS A FAILSAFE FEATURE SHOULD RADIO KEY UP DUE TO CONTROL CIRCUIT FAILURE. TX LAMP FAILURE CAN SIMULATE THIS CONDITION.
16. IT IS POSSIBLE FOR RADIO TO OPERATE FLAWLESSLY BUT STILL NOT WORK IN THE SYSTEM IF THE SUBSCRIBER HAS BEEN DENIED ACCESS BY SYSTEM OWNER.

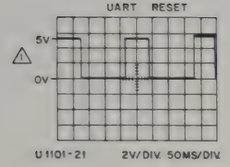
Radio System Troubleshooting Chart
*Motorola No. **DEPS-30984-A***
1/15/81-PHI

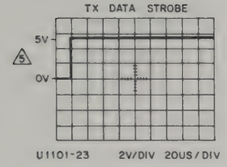

RECEIVE HEX 'FF' ON SUBFLEET A VOL SET OFF AND PTT OFF
YES
NO
ALL SUBFLEET LIGHTS COME ON BRIGHT WHEN ON THAT SUBFLEET DIM AT ALL OTHER TIMES
YES
NO
CHECK THE BULB IN FAILURE AND ASSOCIATED CIRCUITRY
DOES THE VOL. SET FUNCTION PROPERLY?
YES
NO
CHECK U1105D AND ASSOCIATED CIRCUITRY
DOES PTT FUNCTION PROPERLY?
NO
CHECK U1105A AND ASSOCIATED CIRCUITRY
YES
WHICH DIGIT IS IN ERROR?
MSD
CHECK U1105 AND ASSOCIATED CIRCUITRY
CHECK U1110C AND ASSOCIATED CIRCUITRY
NO
DOES U1101-21 TOGGLE WHEN THE GATE OF CR1103 IS GROUNDED?
YES
NO
DOES THE BUSY LIGHT TURN ON WHEN THE BUSY COMMAND IS SENT TO THE BOARD?
YES
NO
CHECK U1107 1 IT SHOULD GO HIGH WHEN THE BUSY COMMAND IS SENT
YES
NO
CHECK Q1102, DS1108 AND ASSOCIATED CIRCUITRY
CHECK U1101-18 FOR RDAR
3
NO
YES
CHECK C1109 AND CR1103
DOES THE CODE PLUG FUNCTION PROPERLY?
YES
NO
RETURN TO 1
REFER TO RADIO SYSTEM TROUBLESHOOTING CHART DEPS-30984
IT THERE A NEGATIVE PULSE AT U1107-3?
YES
NO
DOES U1107-5 PULSE HIGH?
YES
NO
CHECK U1107A AND ASSOCIATED CIRCUITRY
CHECK U1101
CHECK U1109D AND ASSOCIATED CIRCUITRY
YES
IS THERE A NEGATIVE PULSE AT U1109-12 & 13
NO
CHECK U1102A AND ASSOCIATED CIRCUITRY
CHECK Q1103 AND ASSOCIATED CIRCUITRY
4
YES
DO U1105-11 AND 13 GO LOW?
YES
NO
DOES U1102-4 GO LOW?
NO
CHECK U1102A AND ASSOCIATED CIRCUITRY
CHECK U1105

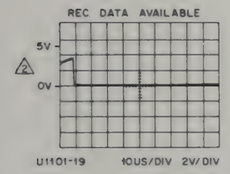
• EEPS-30821-0

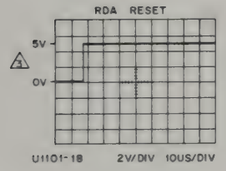


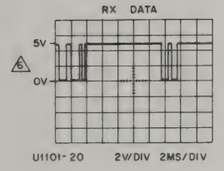
Personality Board Serial Link Troubleshooting Chart
*Motorola No. **DEPS-30987-O***
10/30/80-PHI

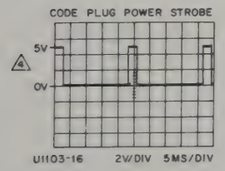


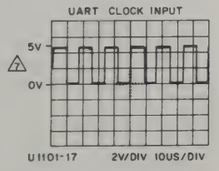


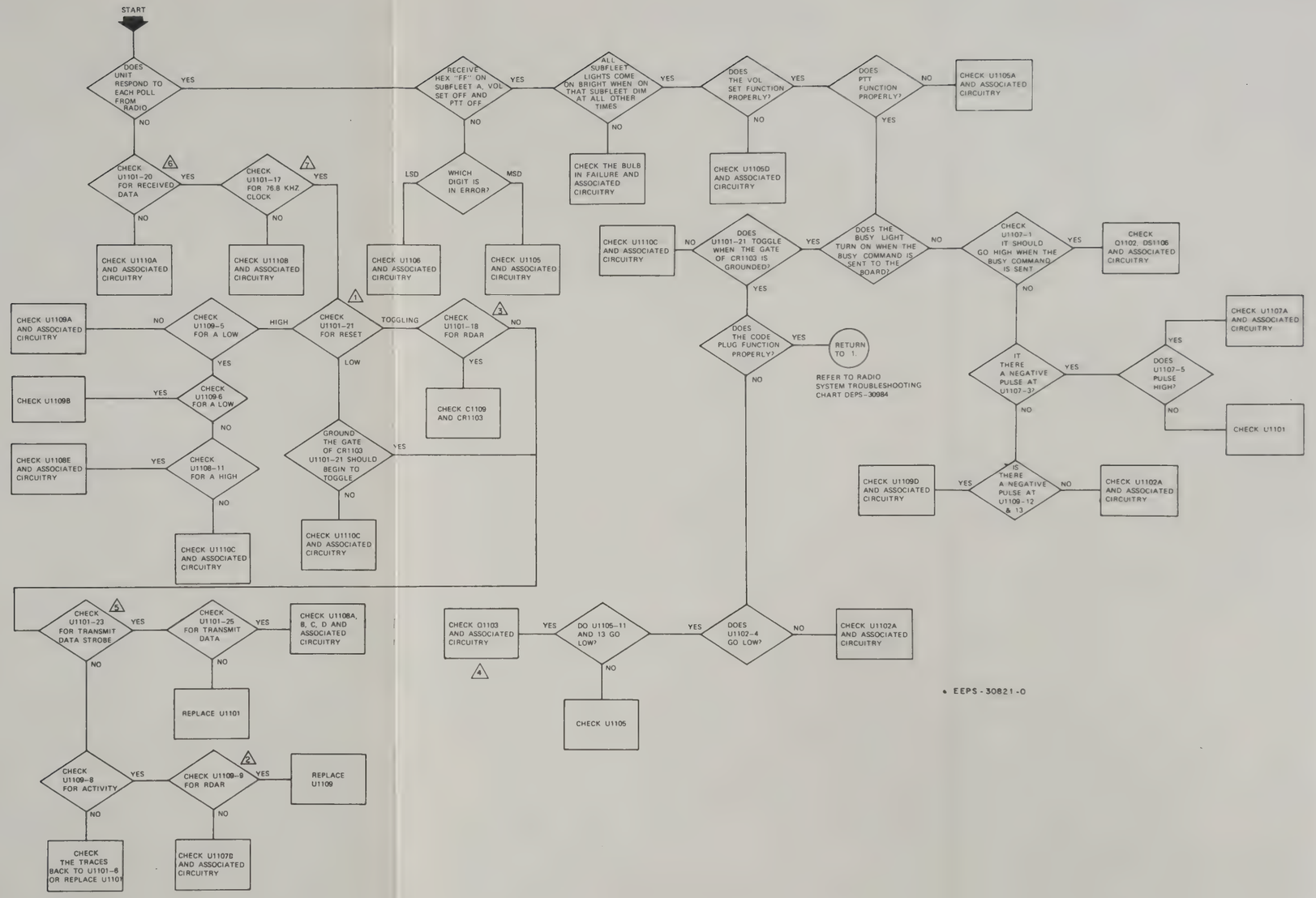




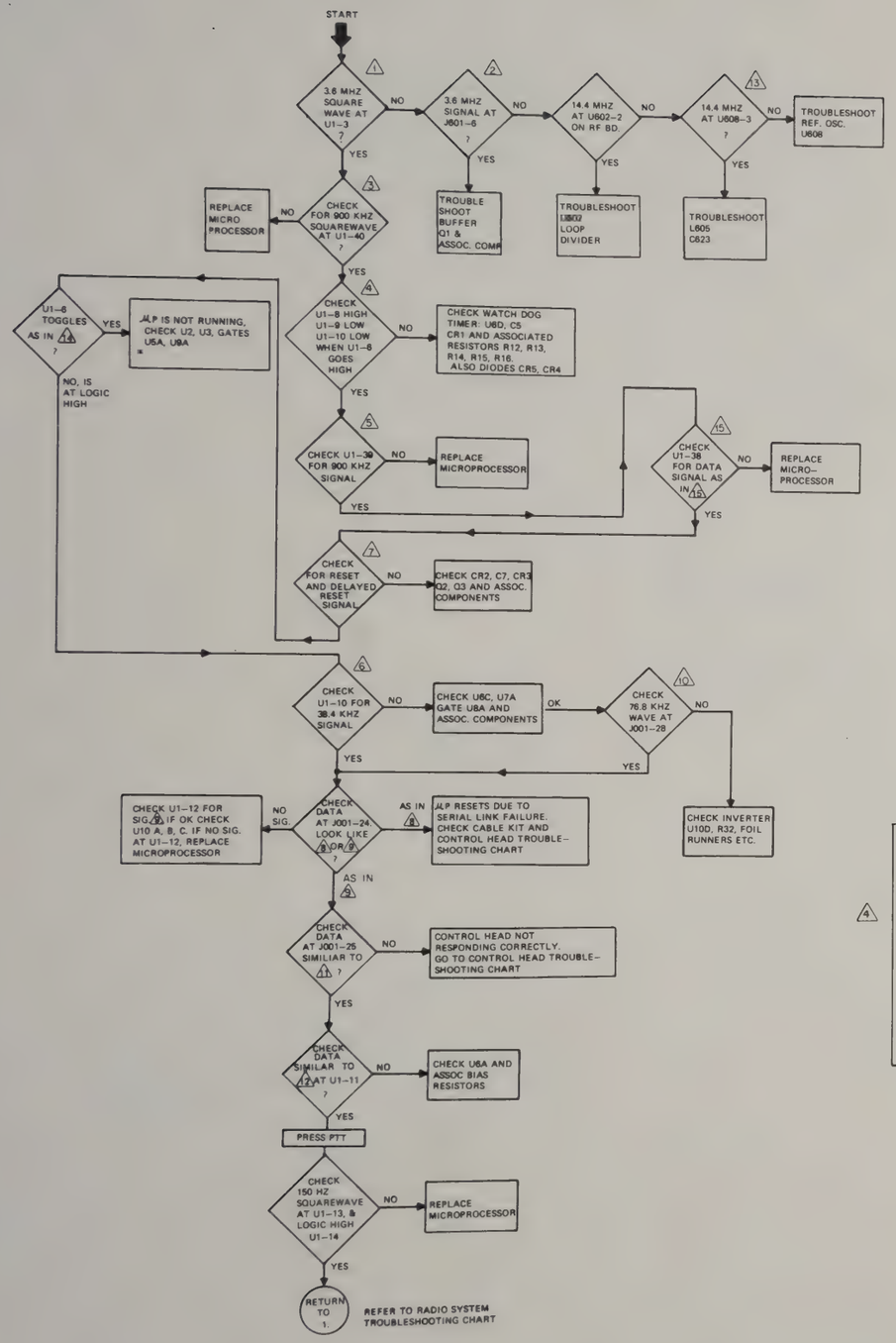




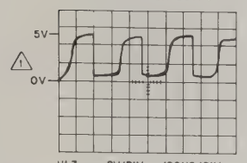




Control Head Troubleshooting Chart
Motorola No. EEPS-30821-O
10/30/80-PHI

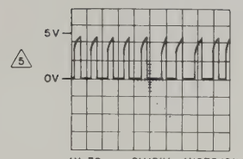


CLOCK BUFFER OUTPUT



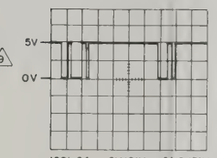
U1-3 2V/DIV. 100NS/DIV

ADDRESS STROBE



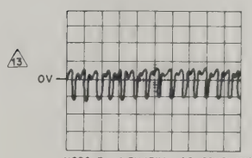
U1-39 2V/DIV. 1USEC/DIV

SERIAL TX DATA



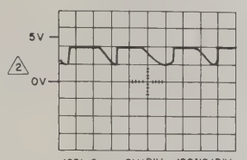
J001-24 2V/DIV 2MS/DIV

14.4 MHZ REF OSC



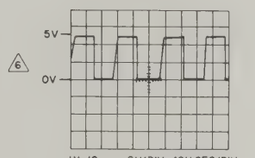
U608-3 0.5V/DIV. AC COUPLING 100 NS/DIV

CLOCK BUFFER INPUT



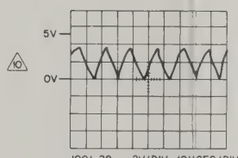
J601-6 2V/DIV. 100NS/DIV.

SERIAL CLOCK INPUT



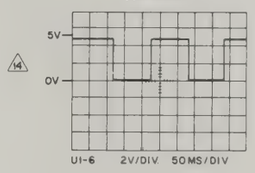
U1-10 2V/DIV. 10U SEC/DIV

SERIAL CLOCK



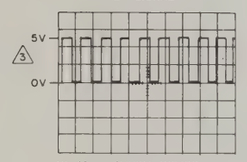
J001-28 2V/DIV 10USEC/DIV

µP RESET



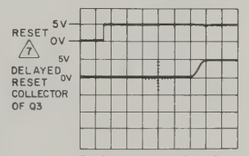
U1-6 2V/DIV. 50MS/DIV

"E" SIGNAL



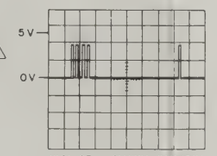
U1-40 2V/DIV. 1US/DIV.

RESET



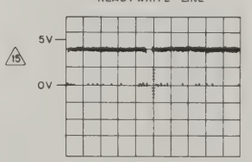
5V/DIV 100MS/DIV

SERIAL RX DATA

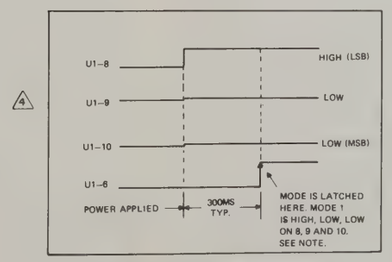


J001-25 2V/DIV 2MS/DIV

READ/$\overline{\text{WRITE}}$ LINE

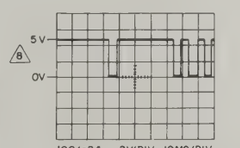


U1-38 2V/DIV. 50US/DIV



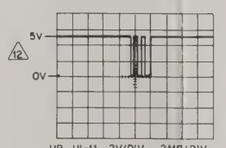
NOTE: THE MODE IS LATCHED ON THE RISING EDGE OF THE RESET LINE. SINCE U1–8, 9, 10 ARE HIGH, LOW, AND LOW RESPECTIVELY, THE THREE BITS THUS FORMED CREATE A 3 BIT DATA WORD WITH A BINARY VALUE OF 1. THUS MODE 1 IS SELECTED AT POWER–UP.

SERIAL TX DATA (WAKE-UP)



J001-24 2V/DIV. 10MS/DIV

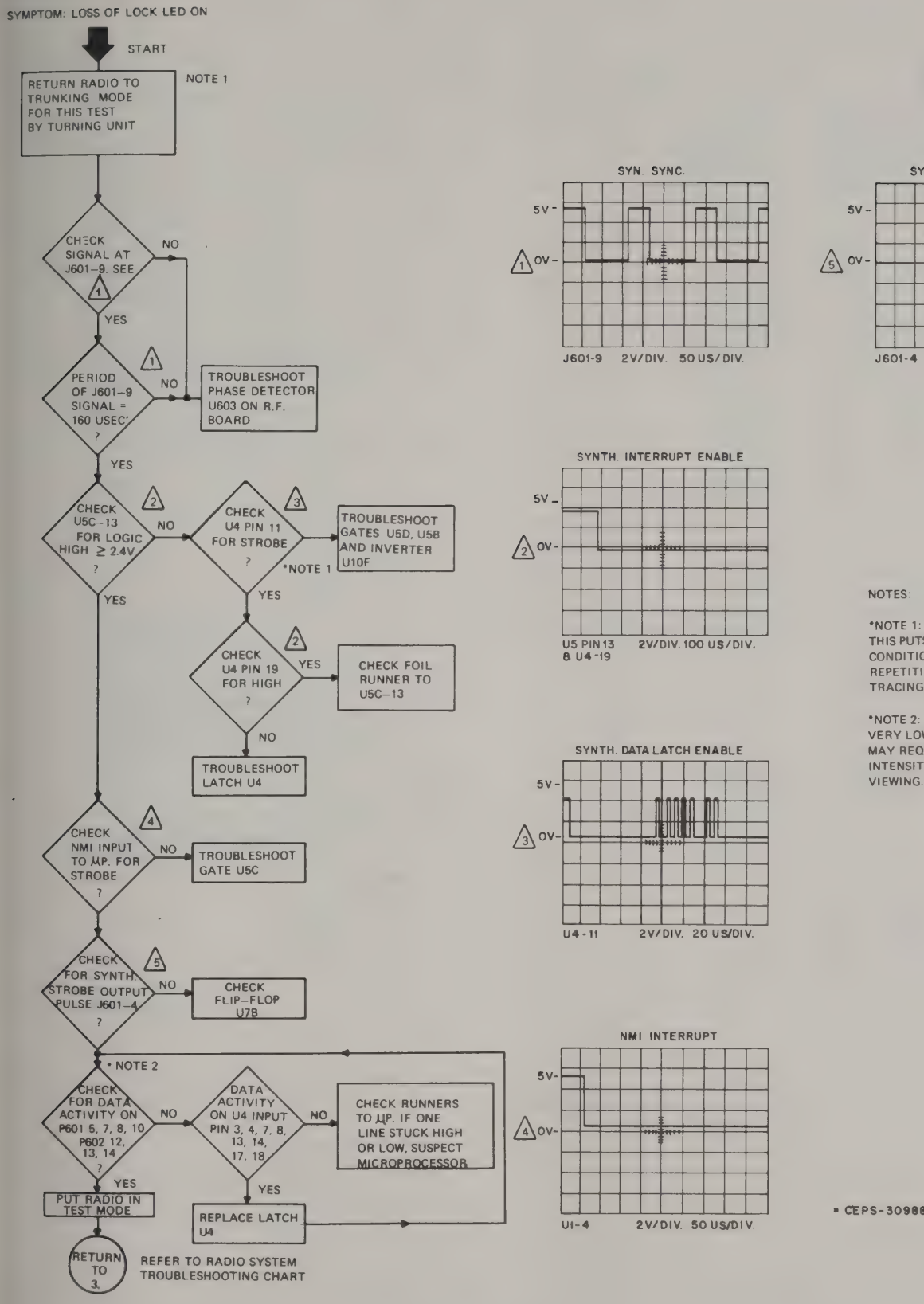
SERIAL RX DATA TO UP



UP U1-11 2V/DIV. 2MS/DIV

• EEPS–30987-O

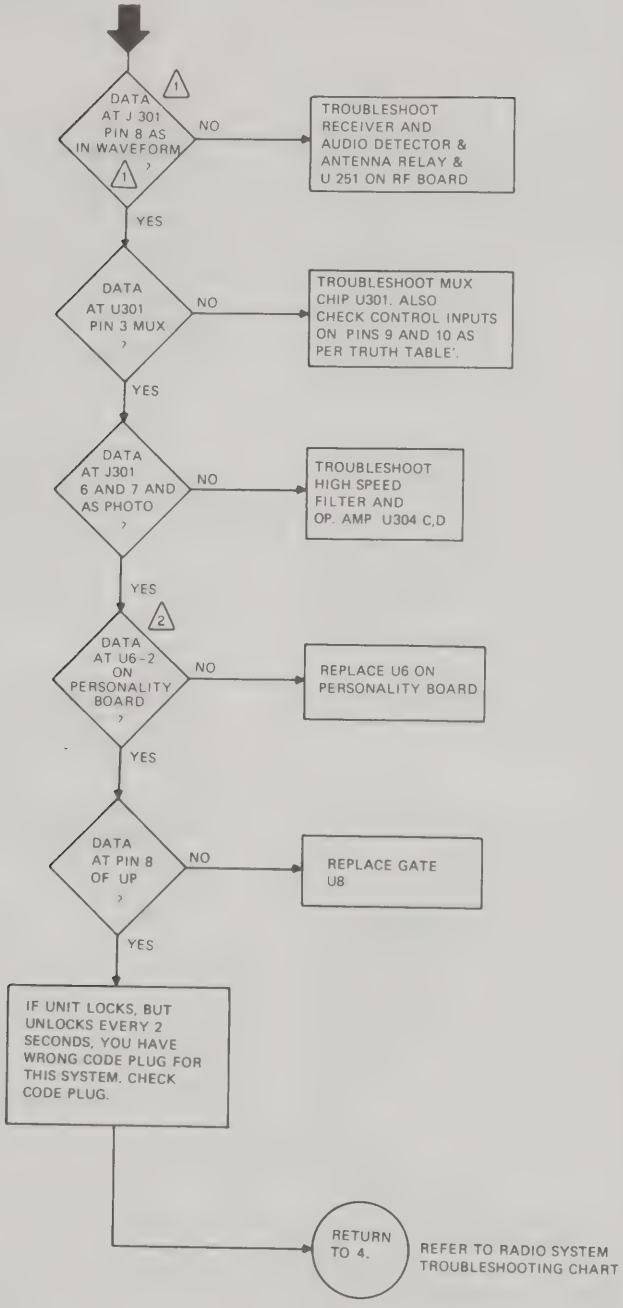
Personality Board Serial Link Troubleshooting Chart
Motorola No. ***DEPS-30987-O***
10/30/80-PHI

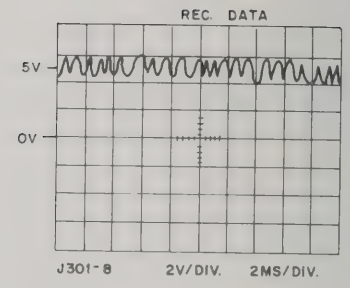


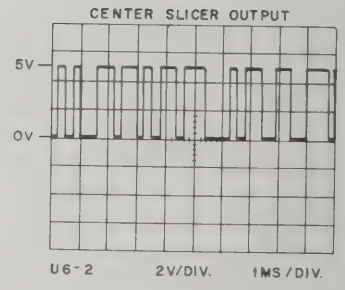
Trunked Personality Board Synthesizer Section Troubleshooting Chart
Motorola No. CEPS-30988-O
10/30/80-PHI

TROUBLESHOOTING FLOWCHART
FOR CENTER SLICER

SYMPTOM: FLASHING LOSS OF LOCK LED

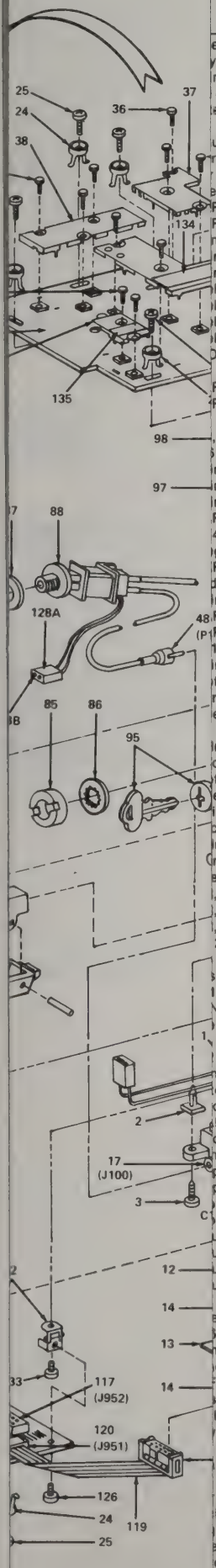






◂ CEPS-30986-O

Center Slicer Troubleshooting Chart
Motorola No. ***CEPS-30986-O***
10/30/80-PHI



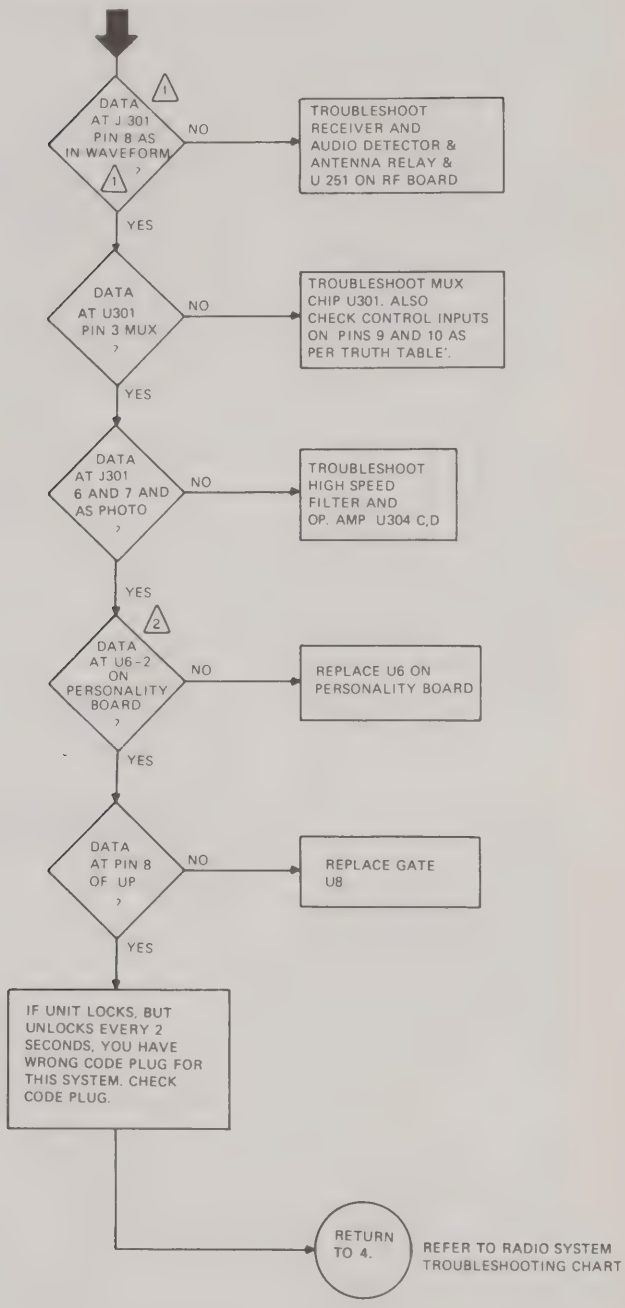
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		DESCRIPTION
		ernal casting
		ylon; 4 used
		ng: 4.2 x 1.41 x 19 mm; 4 used
		mesh
		e
		ubstrate
		r
		er
		RD, mixer
		RD, preamplifier
		nplifier
		ng: 3.5 x 0.6 x 6 mm; 18 used
		ng: 3.5 x 0.6 x 25 mm; 4 used
		lector (6-cell)
		lector (2-cell)
		lector (3-cell)
		lector tuning
		ONNECT
		RD, personality (solder side)
		RD, personality (component
		, female; 14-contact
		used
		ng: 3.5 x 0.6 x 8 mm; 13 used
		ng: 3.5 x 0.6 x 16 mm
		ng: 3.5 x 0.6 x 25 mm
		RD, filter
		4-conductor (incl. P301)
		gulator
		RD, common circuits
		d
		ng: 3.5 x 0.6 x 6 mm; 2 used
		RD, rf (solder side)
		RD, rf (component side)
		1 used
		ng: 11 used
		tive filter (solder side)
		r IF (solder side)
		er/phase detector (solder
		rature detector (solder side)
		component side); 7 used
		tive filter (component side)
		er/phase detector
		ide)
		caler (component side)
		rature detector
		r IF (component side); 4 used
		e (component side)
		, phono, male
		, male: 2-contact
		, male: 3-contact
		2 used
		used
		sed
		10 used
		NG
		r lift
		2 used
		used
		nting
		om cover
		cover
		RD, directional coupler
		over
		hru (power amplifier)
		p positive)
		p negative)
		ttom negative)
		ttom positive)
		us bar
		us bar
		us bar
		us bar
		e
		5 used
		nonic filter
		onic filter
		ILTER, substrate
		h
		lower bus
		ire receptacle; 2 used
		ndle pivot; 2 used
		k
		nna
		er release

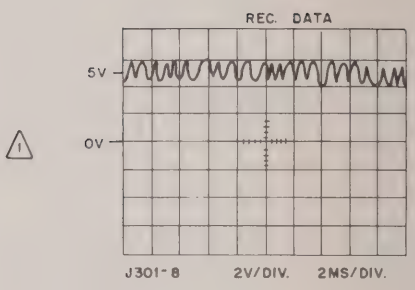
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
90	41-80155B01	SPRING, cover release
91	42-80156B01	RETAINER, ring
92	55-80157B01	CATCH, cover release
93	75-838826	BUMPER, rubber
94	3-10943D48	SCREW, tapping: 5.0 x 0.8 x 16 mm; 2 used
95	55-84101B01	LOCK W/KEY
96	15-80159B01	HOUSING, lock
97	55-80161B01	CATCH, lock
98	41-80160B01	SPRING, lock
99	15-80174B01	COVER' bottom
100	15-80105B01	HOUSING, radio
101	3-10943D32	SCREW, tapping: 3.5 x 0.6 x 16 mm; 5 used
102	4-80149A01	WASHER, captive; 5 used
103	15-80106B01	COVER, top
104	3-10905A05	SCREW, machine: 3.0 x 0.5 x 8 mm; 15 used
105	3-10943D20	SCREW, tapping: 3.0 x 0.5 x 8.0 mm; 6 used
106	42-83982M01	CLAMP, cable
107	TRN8851A	CIRCUIT BOARD, power amplifier
108	TRN8855A	CIRCUIT BOARD, metering
109	42-84367M01	CLIP, wire hold-down; 2 used
110	TRN8854A	CIRCUIT BOARD, final amplifier
111	TRN8853A	CIRCUIT BOARD, driver
112	TRN8852A	CIRCUIT BOARD, pre-driver
113	32-80219B01	GASKET, front connector
114	1-80726D99	FRONT CONNECTOR ASSEMBLY, male: 37-contact
115	28-82647K02	CONNECTOR, male: 10-contact; 2 used
116	28-83603M01	CONNECTOR, male: 20-contact
117	9-84207B01	SOCKET, metering: 7-contact; 4 used
118	9-83445L09	CONNECTOR, female: 10-contact
119	30-83602M01	CABLE, 20-conductor (incl. P401)
120	28-84647L04	CONNECTOR, right angle; 6-contact
121	54-83895M01	LABEL, frequency
122	—	not used
123	4-84152B01	WASHER, shoulder; 4 used
124	14-83820M02	INSULATOR, transistor (Q148, 149, 1001, 1002)
125	26-83498M01	HEATSINK, audio PA
126	3-83741M01	SCREW, tapping: 3.0 x 8 mm; 4 used
127	4-84180C01	WASHER, shoulder
128A	15-84301K16	CONNECTOR, housing: 2-position
128B	39-82717M01	CONTACT, receptacle; 2 used
130	55-84300B02	HANDLE: short
131	32-83997M01	GASKET, feedthru
132	75-82200H13	PAD, oscillator
133	75-82200H14	PAD, oscillator
134	14-84690M01	INSULATOR
135	14-84690M02	INSULATOR
136	14-84691M01	INSULATOR
137	14-84691M02	INSULATOR
	non-referenced items	
	54-84342M01	LABEL, floating grid (mixer cover, VCO cover); 2 used
	54-84126C01	LABEL, Motorola Rep. Parts casting wall
	54-84659M01	LABEL, patent (buffer cover)
	54-850440	LABEL, FCC

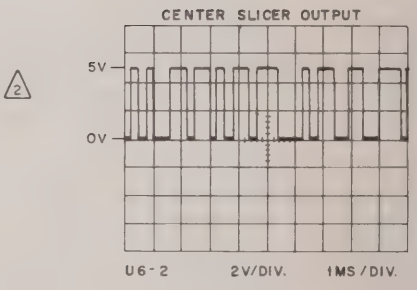
Exploded View of Trunked SYNTOR X Radio and Mechanical Parts List
*Motorola No. **PEPS-30889-A***
(Sheet 1 of 2)
1/15/81-PHI

TROUBLESHOOTING FLOWCHART
FOR CENTER SLICER

SYMPTOM: FLASHING LOSS OF LOCK LED

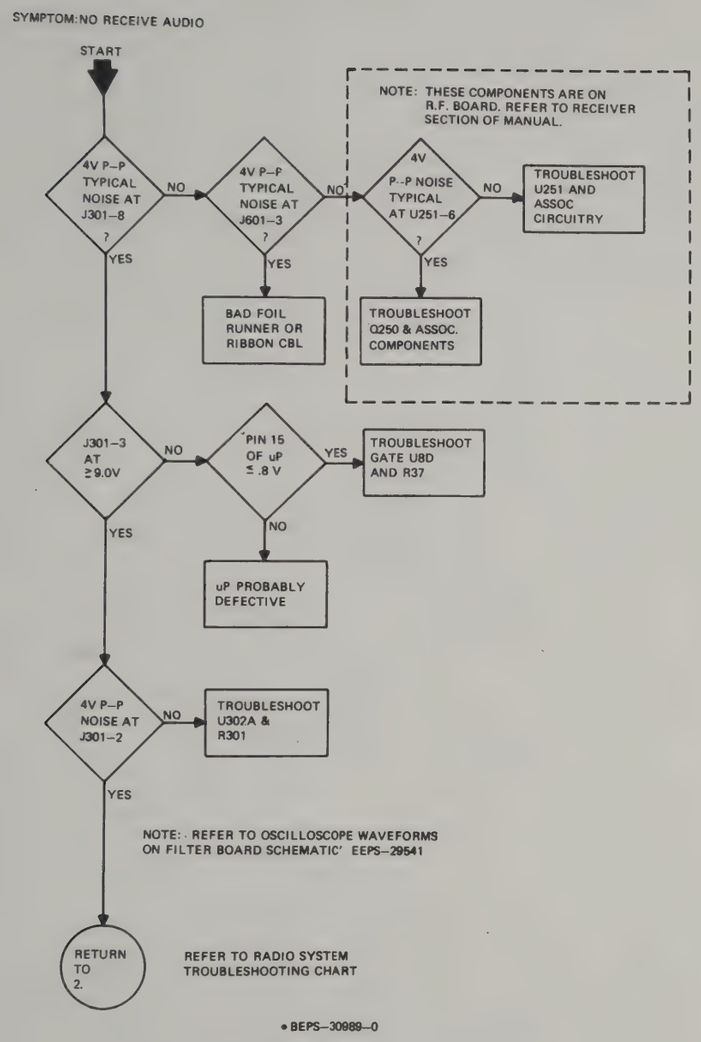






CEPS-30986-O

Center Slicer Troubleshooting Chart
Motorola No. ***CEPS-30986-O***
10/30/80-PHI



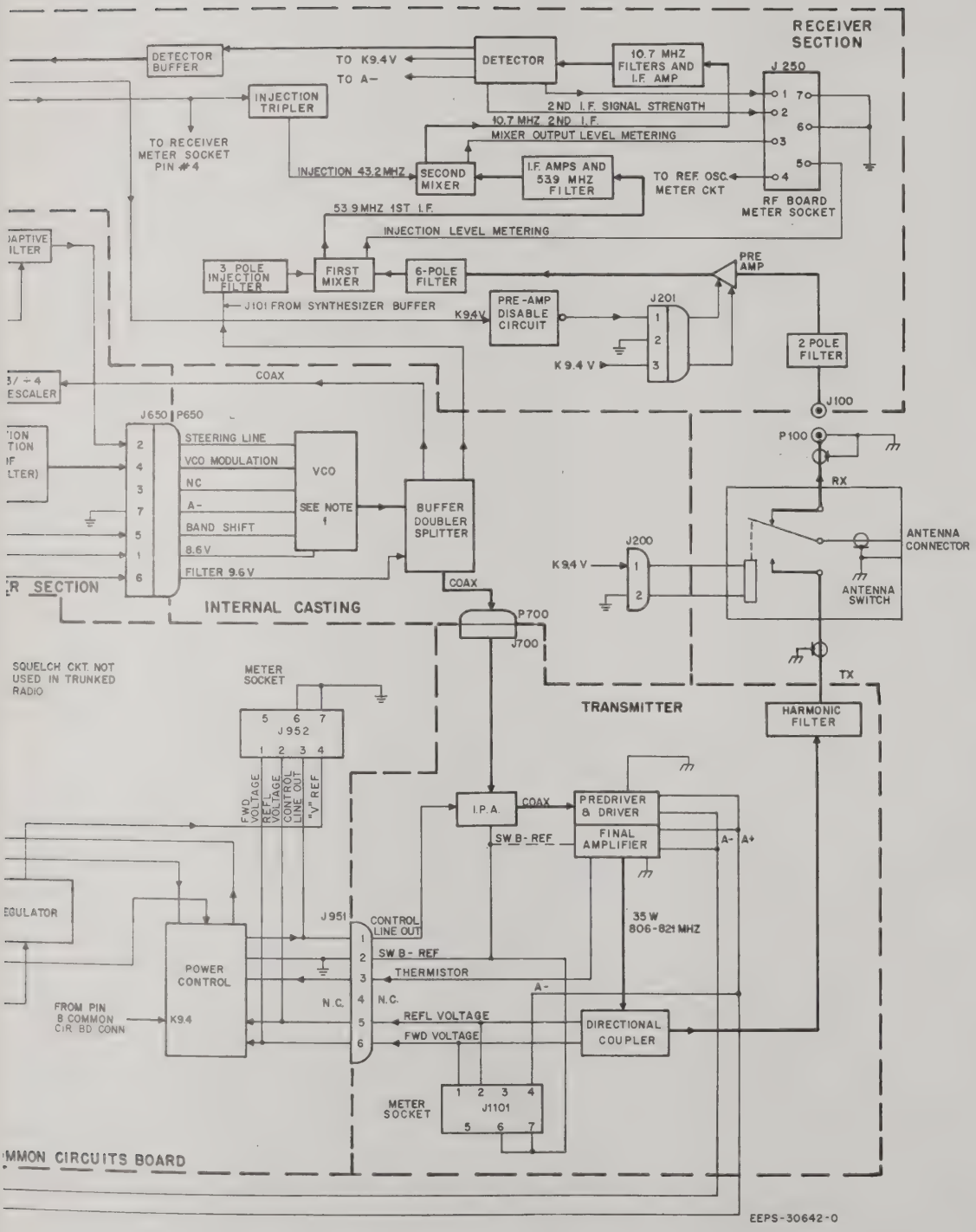
Trunked Filter Board Troubleshooting Chart
Motorola No. CEPS-30989-O
10/30/80-PHI

NOTES:

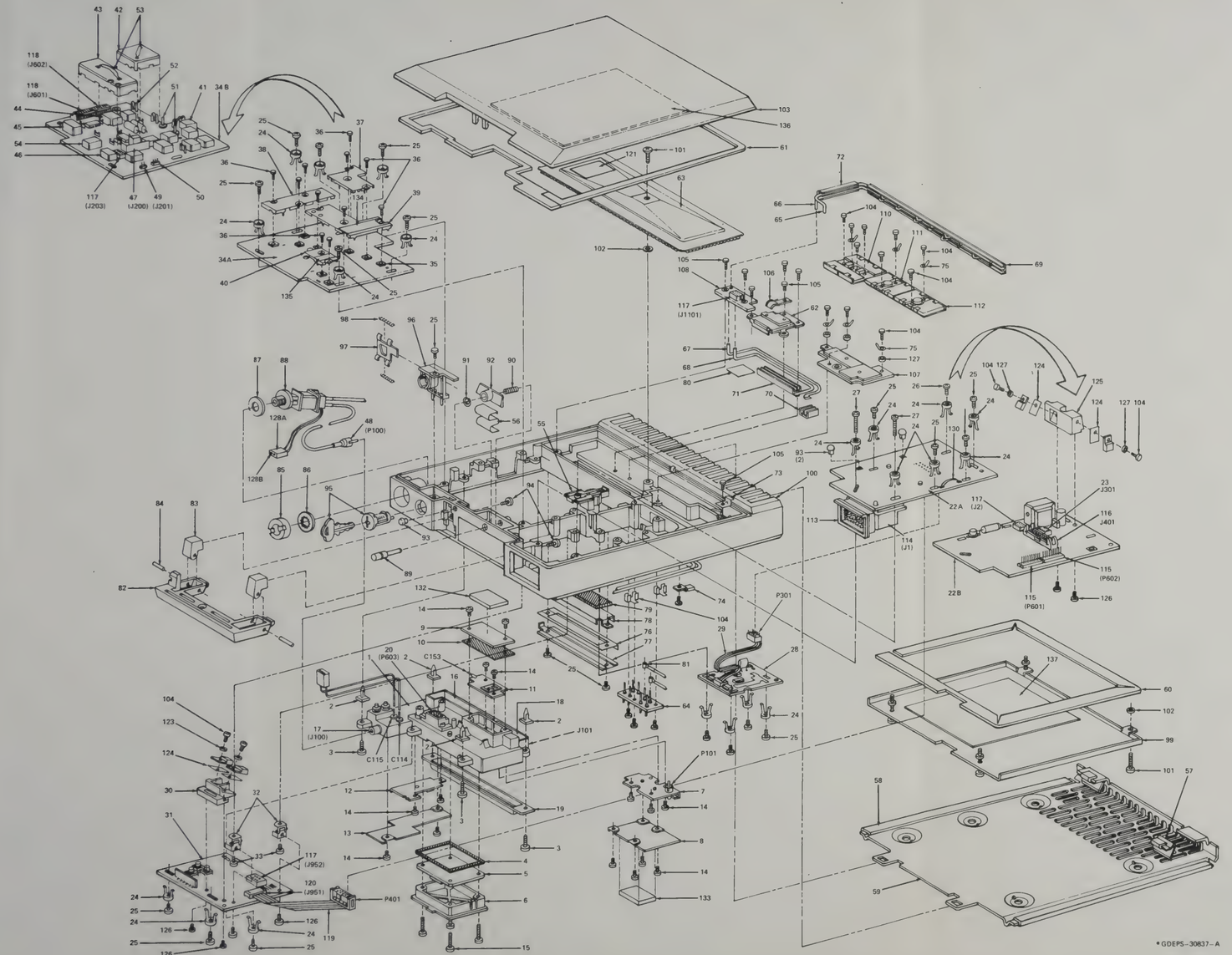
1 DURING RECEIVE, THE VCO OSCILLATES AT: $f_{VCO} = \frac{f_{RX}-53.9}{2}$

DURING TRANSMIT, THE VCO OSCILLATES AT: $f_{VCO} = \frac{f_{TX}}{2}$

2. ⟶ = MAIN AUDIO SIGNAL PATH



EEPS-30642-O

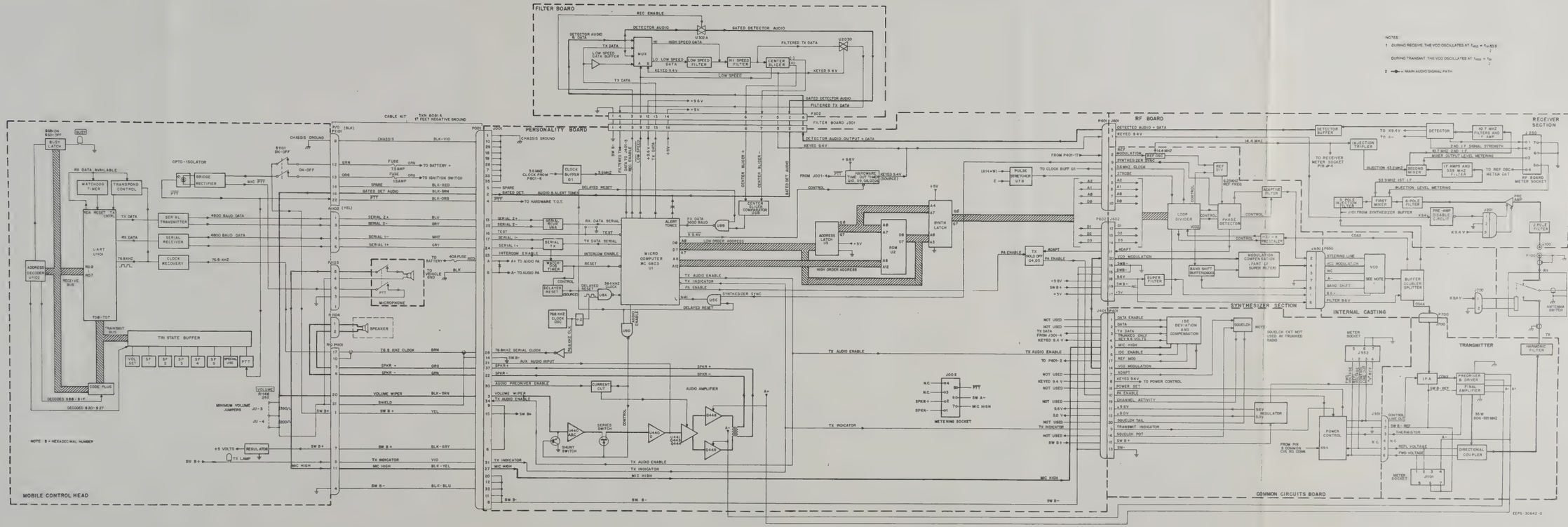


parts list

Trunked Radio Mechanical Parts PL-7052-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	15-80230B01	HOUSING, internal casting
2	14-80206B01	GROMMET, nylon; 4 used
3	3-83959M01	SCREW, tapping: 4.2 x 1.41 x 19 mm; 4 used
4	32-82796H01	GASKET, wire mesh
5	TRN8870A	VCO, substrate
6	15-80206B01	COVER, VCO
7	TRN8871A	VCO, buffer, substrate
8	15-83501M01	COVER, buffer
9	15-80208B01	COVER, mixer
10	32-84486M01	GASKET, mixer
11		CIRCUIT BOARD, mixer
12	TRN8868A	CIRCUIT BOARD, preamplifier
13	15-80207B01	COVER, preamplifier
14	3-10943D28	SCREW, tapping: 3.5 x 0.6 x 6 mm; 18 used
15	3-10943D34	SCREW, tapping: 3.5 x 0.6 x 25 mm; 4 used
16	15-80209B01	COVER, preselector (6-cell)
17	15-80210B01	COVER, preselector (2-cell)
18	15-80210B02	COVER, preselector (3-cell)
19	15-83894M01	COVER, preselector tuning
20	TRN8872A	VCO INTERCONNECT
21		not used
22A	—	CIRCUIT BOARD, personality (solder side)
22B	—	CIRCUIT BOARD, personality (component side)
23	9-84924E05	CONNECTOR, female; 14-contact
24	42-83503M01	RETAINER, 16 used
25	3-10943D29	SCREW, tapping: 3.5 x 0.6 x 8 mm; 13 used
26	3-10943D32	SCREW, tapping: 3.5 x 0.6 x 16 mm
27	3-10943D34	SCREW, tapping: 3.5 x 0.6 x 25 mm
28	—	CIRCUIT BOARD, filter
29	30-83776M01	CABLE, flat: 14-conductor (incl. P301)
30	26-83398M01	HEATSINK, regulator
31	—	CIRCUIT BOARD, common circuits
32	55-83493M01	HINGE; 2 used
33	3-10943D28	SCREW, tapping: 3.5 x 0.6 x 6 mm; 2 used
34A	—	CIRCUIT BOARD, rf (solder side)
34B	—	CIRCUIT BOARD, rf (component side)
35	5-84220B01	GROMMET; 11 used
36	3-84256M01	SCREW, tapping: 11 used
37	26-83588M01	SHIELD, adaptive filter (solder side)
38	26-83586M01	SHIELD, lower IF (solder side)
39	26-83585M01	SHIELD, divider/phase detector (solder side)
40	26-83587M01	SHIELD, quadrature detector (solder side)
41	26-83594M01	SHIELD, can (component side); 7 used
42	26-83592M01	SHIELD, adaptive filter (component side)
43	26-83593M01	SHIELD, divider/phase detector (component side)
44	26-83597M01	SHIELD, prescaler (component side)
45	26-83595M01	SHIELD, quadrature detector
46	26-83596M01	SHIELD, lower IF (component side); 4 used
47	26-83814M01	SHIELD, fence (component side)
48	28-84282D01	CONNECTOR, phono, male
49	28-84324M01	CONNECTOR, male: 2-contact
50	28-84324M02	CONNECTOR, male: 3-contact
51	48-83948M01	GUIDE POST; 2 used
52	42-83891L01	CLIP, mixer; 5 used
53	55-84300B02	HANDLE; 2 used
54	42-80134B01	CLIP, speed; 10 used
55	TRN8857A	PA BUS WIRING
56	41-80158B01	SPRING, cover lift
57	41-80172B01	SPRING, clip; 2 used
58	7-80173B01	RAIL, guide; 2 used
59	7-80171B01	FRAME, mounting
60	32-80175B01	GASKET, bottom cover
61	32-80176B01	GASKET, top cover
62	TRN8856A	CIRCUIT BOARD, directional coupler
63	26-80169B01	SHIELD, PA cover
64	1-80723D66	PLATE, feedthru (power amplifier)
65	30-80136B01	WIRE, bus (top positive)
66	30-81037B01	WIRE, bus (top negative)
67	30-80121B01	WIRE, bus (bottom negative)
68	30-80120B01	WIRE, bus (bottom positive)
69	42-83927M01	RETAINER, bus bar
70	42-83674M02	RETAINER, bus bar
71	42-83674M02	RETAINER, bus bar
72	42-83674M04	RETAINER, bus bar
73	42-81067B01	CLIP, top bus
74	42-80201B01	CLIP, bus wire
75	29-84093M01	LUG, solder; 5 used
76	32-83896M01	GASKET, harmonic filter
77	15-80124B01	COVER, harmonic filter
78	TRN8850A	HARMONIC FILTER, substrate
79	32-83926M01	GASKET, mesh
80	14-83901M01	INSULATOR, lower bus
81	29-83897M01	TERMINAL, wire receptacle; 2 used
82	55-80107B01	HANDLE
83	7-80152B01	BRACKET, handle pivot; 2 used
84	22-83491M01	PIN, spring
85	2-80006A01	NUT, spanner
86	4-114522	WASHER, lock
87	32-80080A01	GASKET, ring
88	TRN4734A	SWITCH, antenna
89	38-80154B01	BUTTON, cover release
90	41-80155B01	SPRING, cover release
91	42-80156B01	RETAINER, ring
92	55-80157B01	CATCH, cover release
93	75-538626	BUMPER, rubber
94	3-10943D48	SCREW, tapping: 5.0 x 0.8 x 16 mm; 2 used
95	55-84101B01	LOCK W/KEY
96	15-80159B01	HOUSING, lock
97	55-80161B01	CATCH, lock
98	41-80160B01	SPRING, lock
99	15-80174B01	COVER' bottom
100	15-80105B01	HOUSING, radio
101	3-10943D32	SCREW, tapping: 3.5 x 0.6 x 16 mm; 5 used
102	4-80149A01	WASHER, captive; 5 used
103	15-80106B01	COVER, top
104	3-10905A05	SCREW, machine: 3.0 x 0.5 x 8 mm; 15 used
105	3-10943D20	SCREW, tapping: 3.0 x 0.5 x 8.0 mm; 6 used
106	42-83982M01	CLAMP, cable
107	TRN8851A	CIRCUIT BOARD, power amplifier
108	TRN8855A	CIRCUIT BOARD, metering
109	42-84367M01	CLIP, wire hold-down; 2 used
110	TRN8854A	CIRCUIT BOARD, final amplifier
111	TRN8853A	CIRCUIT BOARD, driver
112	TRN8852A	CIRCUIT BOARD, pre-driver
113	32-80219B01	GASKET, front connector
114	1-80726D99	FRONT CONNECTOR ASSEMBLY, male: 37-contact
115	28-82647K02	CONNECTOR, male: 10-contact; 2 used
116	28-83603M01	CONNECTOR, male: 20-contact
117	9-84207B01	SOCKET, metering: 7-contact; 4 used
118	9-83445L09	CONNECTOR, female: 10-contact
119	30-83602M01	CABLE, 20-conductor (incl. P401)
120	28-84647L04	CONNECTOR, right angle; 6-contact
121	54-83895M01	LABEL, frequency
122	—	not used
123	4-84152B01	WASHER, shoulder; 4 used
124	14-83820M02	INSULATOR, transistor (Q148, 149, 1001, 1002)
125	26-83498M01	HEATSINK, audio PA
126	3-83741M01	SCREW, tapping: 3.0 x 8 mm; 4 used
127	4-84180C01	WASHER, shoulder
128A	15-84301K16	CONNECTOR, housing: 2-position
128B	39-82717M01	CONTACT, receptacle; 2 used
130	55-84300B02	HANDLE: short
131	32-83997M01	GASKET, feedthru
132	75-82200H13	PAD, oscillator
133	75-82200H14	PAD, oscillator
134	14-84690M01	INSULATOR
135	14-84690M02	INSULATOR
136	14-84691M01	INSULATOR
137	14-84691M02	INSULATOR
	non-referenced items	
	54-84342M01	LABEL, floating grid (mixer cover, VCO cover); 2 used
	54-84126C01	LABEL, Motorola Rep. Parts casting wall
	54-84659M01	LABEL, patent (buffer cover)
	54-850440	LABEL, FCC

Exploded View of Trunked SYNTOR X Radio and Mechanical Parts List
*Motorola No. **PEPS-30889-A***
(Sheet 1 of 2)
1/15/81-PHI



Trunked SYNTOR X Radio Set
Functional Block Diagram
Motorola No. PEPS-30889-A
(Sheet 2 of 2)
1/15/81-PHI

MICROCOMPUTER SYSTEM

(TRUNKED PERSONALITY BOARD AND FILTER BOARD)

1. GENERAL DESCRIPTION

Most major functional blocks of the Trunked SYNTOR X radio are directly controlled by the microcomputer system. The microcomputer system circuits are located on the TLN2237A Trunked Personality Board. The trunked personality board also includes the receive audio circuits of the radio. The trunked personality board determines the operating character or "personality" of the Trunked SYNTOR X radio.

2. MICROCOMPUTER SYSTEM DESCRIPTION

A brief description of the interaction between the microcomputer system and the control head is included for better understanding of the system. A detailed description of the control head circuitry is included in a separate section, "Control Board and Cabling".

A functional block diagram of the trunked personality board and the associated filter board is shown in Figure 1. Trunked radios use a special trunked control head. A functional block diagram of this control head is shown in Figure 2.

As shown in Figure 1, the trunked personality board is controlled by a Motorola MC6803 8-bit microcomputer. The 3.6 MHz CLOCK signal for the microcomputer is provided by the frequency synthesizer. The operating program is contained on a 4k x 8-bit ROM also shown in Figure 1. It should be noted that trunked personality board ROM programming is common to any Trunked SYNTOR X radio, no matter which trunked system it may be operating within. Thus, all Trunked SYNTOR X radios are identical and completely interchangeable. All unique user information (such as receive and transmit frequency assignments along with fleet and subfleet data) is contained within the control head code plug, as shown in Figure 2.

Two-way data communications is provided between the trunked personality board and the control head via two serial links operating at 4800 baud. The SERIAL LINK CLOCK SIGNAL is developed from a 76.8 kHz oscillator on the trunked personality board. The SERIAL LINK CLOCK SIGNAL is divided by 2 before being applied to the microcomputer, as shown in Figure 1. The output of the oscillator is fed to the control head UART (Universal Asynchronous Receiver/Transmitter) via the control cable and a clock buffer, as shown in Figure 2.

The microcomputer periodically requests information from the control head by initiating a request via the receive serial data link and receive bus, shown in Figure 2. In order for the microcomputer to request information on a selective basis, a portion of the receive bus is decoded within the address decode section of the diagram. If, for example, the microcomputer is requesting data from the code plug, an output signal from the address decode circuitry will activate the code plug via the power switch and an additional code plug enable input. The specific information to be retrieved from the code plug is determined by additional addressing information derived from the remaining portion of the receive bus.

Any request for information, via the receive serial data link, will cause the RCV DATA AVAIL output of the UART to switch high. The XMIT/RCV control circuitry will respond by returning a negative transition to the RESET DATA AVAIL and TX/DATA STROBE inputs of the UART. This action will clear the RCV DATA AVAIL output of the UART and place the UART in the transmit mode. In this case, the requested code plug information will be routed to the UART, via the transmit bus, and sent back to the trunked personality board microcomputer over the transmit serial data link.

The microcomputer will also periodically check the status of control head switch positions and the PTT switch by requesting information via the three-state switch buffers. In order to accomplish this, a series of events will be followed which are essentially the same as previously noted. However, in this case, the address decode circuitry will activate the three-state switch buffers instead of the code plug. Also note, in Figure 2, that the receive bus is used to control the busy light via the busy light latch. The busy light is used to indicate to the operator that no voice channels are available.

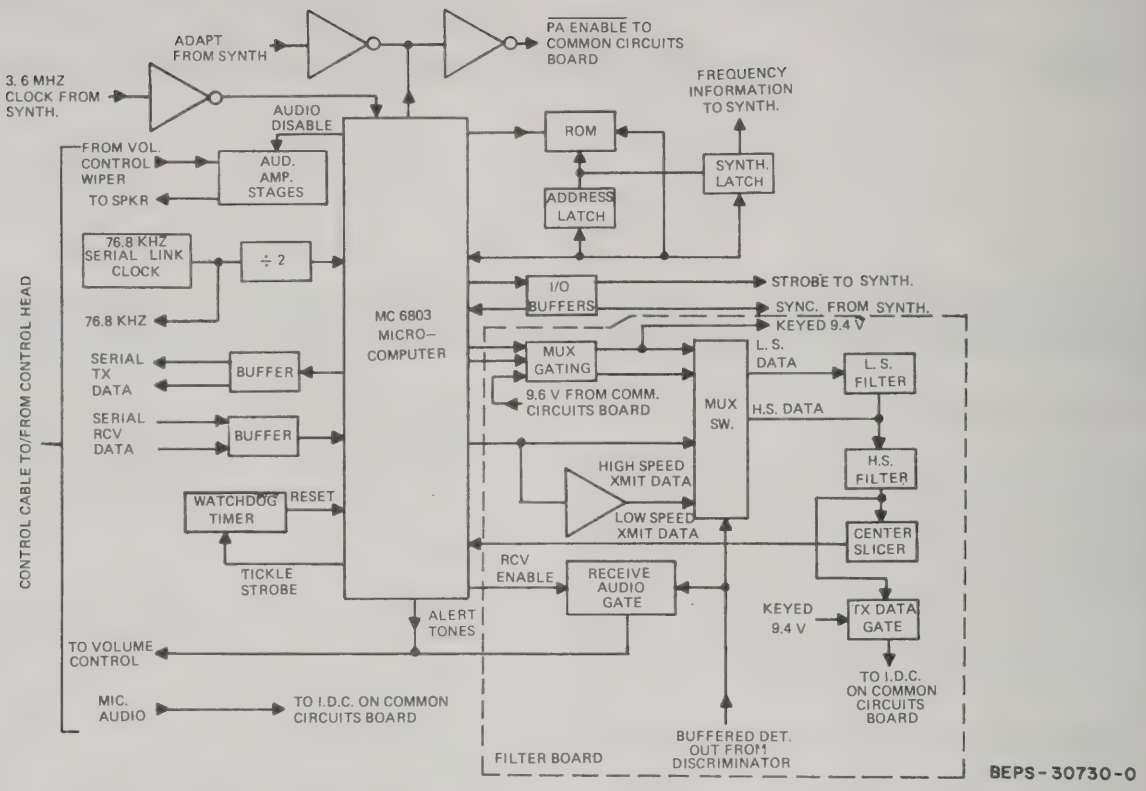


Figure 1. Trunked Personality and Filter Board Functional Block Diagram

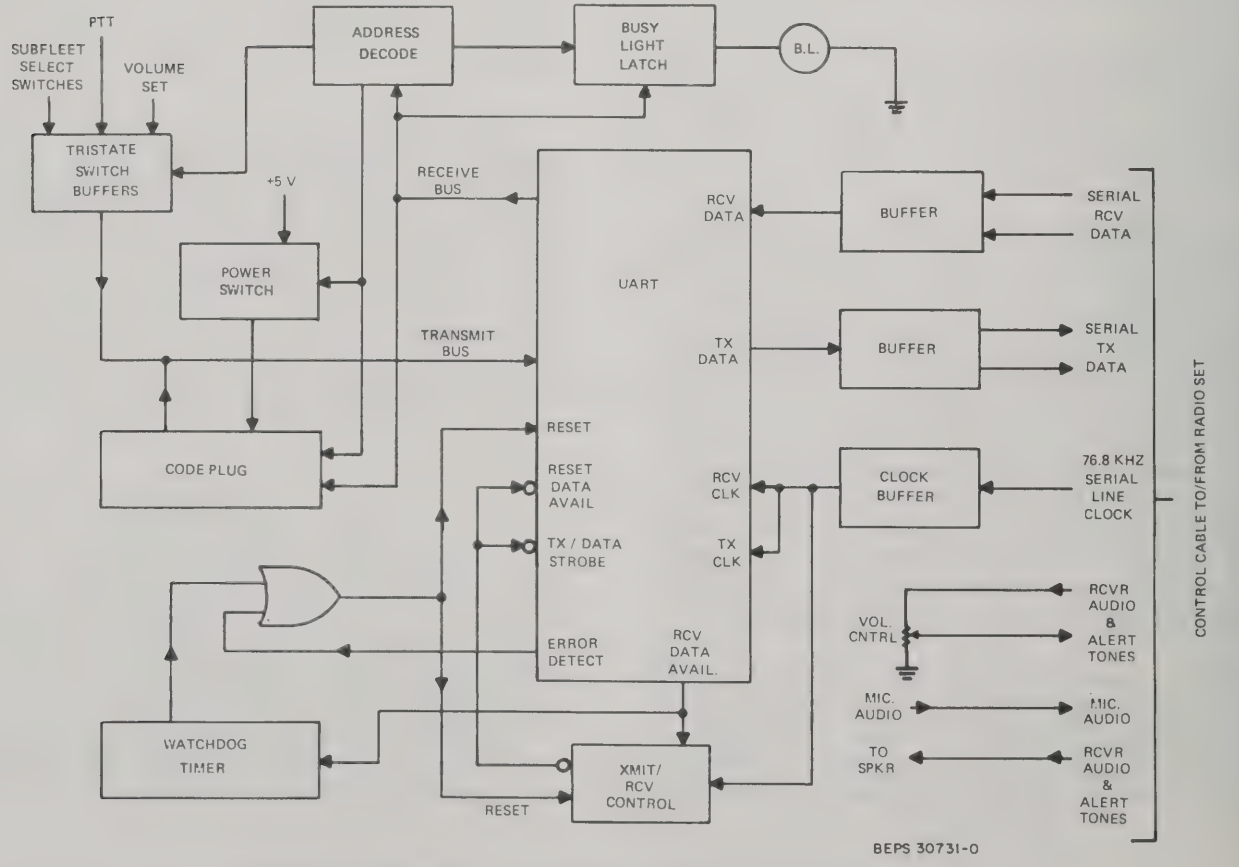


Figure 2. Trunked Control Head Functional Block Diagram

Each time the RCV DATA AVAIL output of the UART pulses the XMIT/RCV control circuitry, it also pulses the watchdog timer which is used for fault detection. Under normal operating conditions, the RCV DATA AVAIL output of the UART will pulse at a rate that maintains the output of the watchdog timer low. If the RCV DATA AVAIL signal is lost (indicating a possible UART malfunction), the watchdog timer will provide a high to the OR gate thus resetting the UART and the XMIT/RCV control logic in an attempt to clear the fault. Also note that the ERROR DETECT output (framing or overrun) of the UART can initiate the same reset action.

Referring to Figure 1, the user frequency allocation information, retrieved from the control head code plug is used by the microcomputer to develop the frequency programming information for the frequency synthesizer. The trunked personality board uses a SYNTH LATCH to relay the addressing and data information to the frequency synthesizer.

The watchdog timer, shown in Figure 1, generates a reset signal to the microcomputer to reset the microcomputer by restarting the program.

The trunked system signaling format requires the processing of both high and low speed data in both the transmit or receive modes. A multiplex (MUX) switch, controlled by the microcomputer via the multiplex (MUX) gating circuitry, works in conjunction with low and high speed filters to provide the proper shaping of these signals.

When transmitting the inbound signaling word (ISW) on the control channel, or when transmitting the 1800 Hz acknowledge tone on the voice channel, the high speed data path must be selected. The microcomputer will control the MUX gating logic in order to select the high speed data path through the MUX switch. In this case, the high speed data is routed from the microcomputer through the MUX switch, the high speed filter and the TX data gate to the IDC circuitry on the common circuits board. Note that the TX data gate is enabled via keyed 9.4 V from the MUX gating circuitry.

When transmitting the low speed connect tone or disconnect tone on the voice channel, the microcomputer will select the low speed data path through the MUX switch by, once again, controlling the MUX gating logic. In this case, the low speed data is routed from the microcomputer through a non-inverting buffer, the MUX switch, both low speed and high speed filters and the TX data gate to the IDC circuitry.

In the receive mode, the background word and the outbound signaling word (OSW) on the control channel, or the high speed handshake signal on the voice channel must be routed through the high speed data path. In this case, the buffered detector output signal from the receiver discriminator is routed through the MUX switch (as controlled by the microcomputer and MUX gating logic), the high speed filter and center slicer then back to the microcomputer for decoding. The low speed handshake or failsoft word, received over the voice channel, must be routed through both the low speed and high speed filters before entering the microcomputer via the center slicer.

The microcomputer also controls the receive audio gate and audio amplifier stages shown in Figure 1. In the receive mode, once the voice channel has been established, these stages will be enabled to allow the receiver output to be heard at the speaker.

In addition, the microcomputer generates various alert tones to indicate unique operational situations. These tones (volume set, talk prohibit, call back, time-out warning, talk permit) are routed from the microcomputer to the speaker via the same path as the receiver output. However, when the alert tones are generated, the microcomputer will disable the receive audio gate to prevent interaction of the tones with the receiver audio output.

3. TRUNKED PERSONALITY BOARD THEORY OF OPERATION

3.1 GENERAL

The trunked personality board is the heart of the Trunked SYNTOR X radio. It consists of a Motorola MC6803 microprocessor, a read only memory (ROM) that contains the operating program, and various supporting and control circuitry. The trunked personality board controls all operations of the trunked radio from lighting the control panel indicators to frequency selection. The detailed theory of operation discussion follows a brief description of the MC6803 microprocessor used on the trunked personality board.

3.2 MC6803 MICROPROCESSOR DESCRIPTION

3.2.1 General

The MC6803 microprocessor, as used in this application, requires an external ROM which contains the operating program. The microprocessor is an 8-bit processor. It contains 128 bytes of internal random access memory (RAM) and an internal universal asynchronous receiver transmitter (UART) that performs the serial communications with the control head. The microprocessor is operated in MODE 1 which is the multiplexed-expanded mode. Software program control operates the processor as a time based, interrupt driven machine to allow all transactions to or from the mobile to operate in time sync with the system central controller.

The MC6803 microprocessor is a 40-pin LSI device configured with four I/O ports as shown in Figure 3. Notice that ports one and two are used for all radio control functions (audio enable, PA enable, etc.) and that port four is used as the high order bits of the 16-bit address bus. Port three is used as the low order bits of the 16-bit address bus and also the 8-bits of the data bus. This function is time shared and is a function of the MC6803 architecture when mode 1 is selected. To utilize the full 16 bit capability of the address bus, the low order 8-bits of address are latched in U3 on the trunked personality board thus freeing these lines to act as bi-directional data lines. The address strobe, U1-39, controls the latching action of U3.

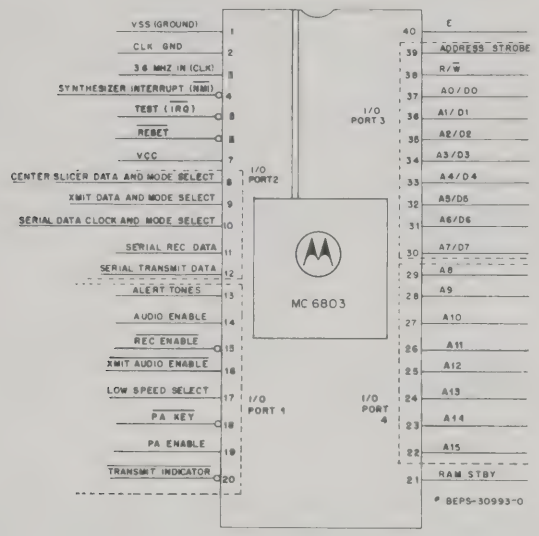


Figure 3.
Motorola MC6803 Microprocessor Pin Configuration

3.2.2 Port 1 Outputs

- ALERT TONES, pin 13

  All tones heard by the mobile operator originate as square waves from this pin.

- AUDIO ENABLE, pin 14

  When this output is low, the audio amplifier stages are shut off. When this output is high, the audio amplifier stages are turned on and the speaker is unmuted.

- $\overline{\text{REC ENABLE}}$, pin 15

  This output goes low when the radio is on a voice channel and voice is present.

- $\overline{\text{XMIT AUDIO ENABLE}}$, pin 16

  This output goes low to enable the microphone audio circuits.

- LOW SPEED SELECT, pin 17

  This output goes high when transmitting or receiving low speed data.

- $\overline{\text{PA KEY}}$, pin 18

  This output goes low to enable the keyed +9.4 volt switch circuit which allows the transmitter to key.

- PA ENABLE, pin 19

  This output goes high to cause the transmitter to key if the synthesizer is still in a locked condition. This output is the primary control over transmitter key-up and shut down.

- $\overline{\text{TRANSMIT INDICATOR}}$, pin 20

  When the transmitter is actually generating power output, the monitor circuit detects this condition and provides a logic low input to this pin which tells the microprocessor that the transmitter is keyed.

3.2.3 Port 2 Inputs/Outputs

During initialization, microprocessor pins 8, 9, and 10 are input pins and the logic condition on these three pins determines the operating mode. Since the microprocessor is used in mode 1 on the personality board, pin 8 is held high and pins 9 and 10 are held low during initialization to achieve mode 1 operation. After initialization, pins 8, 10, and 11 are inputs and pins 9 and 12 are outputs. Each is described in the following:

- CENTER SLICER DATA AND MODE SELECT, Pin 8

  This pin is the least significant bit of the mode select word during initialization. All high and low speed receive data enters the microprocessor through this pin.

- XMIT DATA AND MODE SELECT, Pin 9

  This pin is the middle bit of the mode select word during initialization. All high and low speed transmit data leaves the microprocessor through this pin.

- SERIAL DATA CLOCK AND MODE SELECT, Pin 10

  This pin is the most significant bit of the mode select word. It is also the serial data clock input (38.4 kHz squarewave in this application).

- SERIAL REC DATA, Pin 11

  The 4800 baud serial data from the control head enters the microprocessor through this pin.

- SERIAL TRANSMIT DATA, Pin 12

The 4800 baud serial data to the control head is output from the microprocessor at this pin.

3.2.4 Port 3 Inputs/Outputs

- ADDRESS/DATA ports A0 through A7/D0 through D7, pins 30 through 37

Eight pins are used for the multiplexed address and data bus. These pins provide the lower order address lines plus the eight bit data bus. The data bus is bidirectional for the transfer of data to and from the memory and peripheral devices.

- R/$\overline{W}$, pin 38

This output signals the peripherals and memory devices that the MC6803 is in a Read (high) or Write (low) state.

- ADDRESS STROBE, Pin 39

This output is used to strobe the low order address (A0 through A7) into the address latch, U3.

3.2.5 Port 4, High Order Address

- These outputs are the 8-bit high order address outputs of the microprocessor (A8 through A15). These eight address lines along with the eight low order address lines make up the complete 16-bit address output of the microprocessor.

3.3 DETAILED THEORY OF OPERATION

Refer to the trunked personality board schematic diagram, EEPS-29666, for details. The functional operation of the personality board is described in a "slow motion" fashion following normal operation.

3.3.1 Master Clock

The master clock is developed from the reference divider in the synthesizer which divides down the 14.4 MHz reference oscillator output to 3.6 MHz. Transistor Q1 on the trunked personality board acts as a buffer for the 3.6 MHz signal and provides a processor compatible signal to the microprocessor input at U1-3.

Transistor Q1 operates in the common emitter configuration. The 3.6 MHz input signal is not symmetrical. To compensate for this condition, R3 is chosen to provide additional bias to the base of Q1. The additional bias causes the transistor to remain conducting longer than normal. This adds enough turn off delay to achieve a 50% duty cycle clock input to the microprocessor.

3.3.2 System Initialization

When the trunked radio is first turned on, the microprocessor is placed in the reset mode for 150 ms then allowed to start up while microprocessor pins 9 and 10 are held low and pin 8 is held high for an additional 600 ms. This action assures that the microprocessor starts operating in MODE 1. Start-up is as follows.

When power is first applied to the radio, +5 volts is applied to C5 and to U6D pin 7 through R14 in the watchdog timer circuit. Pin 6 of U6D slowly drops toward 0 volts as C5 charges preventing the output of U6D at pin 1 from going high until C5 charges sufficiently to allow the voltage at pin 6 to drop below the reference voltage at pin 7. This requires approximately 150 ms. When the voltage at pin 6 drops below the voltage at pin 7, the output at U6D pin 1 goes high, the delayed reset timer is started and the microprocessor $\overline{\text{RESET}}$ input goes high allowing the microprocessor to start.

At the same time that the radio is turned on, +5 volts is applied to Q2 and Q3 in the delayed reset timer circuit. This causes Q3 to turn on and remain on until Q2 turns on. When the output of U6D goes high C7 starts charging in the delayed reset timer circuit. Due to the time constant of C7 and R18, Q2 remains shut off for approximately 600 ms after U6D pin 1 goes high. When Q2 turns on, Q3 is shut off. This action provides a 600 ms delay which will properly initialize the microprocessor in MODE 1.

Pins 8, 9, and 10 of the microprocessor, U1, are dual function, acting as input ports during initialization to provide mode selection and as programmable input or output ports during program execution. The output of the delayed reset timer (Q3 collector) is routed to CR4 and U8A pin 4, U8B pin 2 and U9D pin 10, and to U1 pin 9 through CR5. The low delayed reset timer output at the collector of Q3 holds U1 pins 9 and 10 low through CR5 and CR4 respectively and pin 8 high through U8B for the 600 ms delayed reset time. Pins 8, 9, and 10 form a 3 bit word at the input of the microprocessor during initialization that is latched into the processor when the $\overline{\text{RESET}}$ input at U1-6 goes high. The combination of pins 9 and 10 low and pin 8 high causes the processor to operate in program MODE 1.

A delayed reset output from Q2 of the delayed reset timer circuit is routed to Q5 in the PA enable switch circuit. This input to Q5 remains high for the 600 ms delayed reset time which keeps Q5 turned on. With Q5 turned on, Q4 remains off regardless of the condition of the PA enable output at U1 pin 19. This action prevents the processor from inadvertently causing any transmitter power amplifier key up until it is fully initialized and operating.

The delayed reset output from Q3 is routed to one input of U5C through CR15. This input assures that the output of U5C remains low during initialization.

This prevents transfer of any erroneous program information to the synthesizer which may cause it to operate on some undesirable frequency until the processor is fully initialized. The delayed output from Q3 also prevents the output of U9D from going high preventing the receive audio circuitry on the trunked personality board from operating until initialization is completed.

3.3.3 Retrieving Control Head Information

3.3.3.1 General

Once the microprocessor, U1, is initialized and operating, it interrogates the control head for all unique user information such as operating channel assignments, fleet and subfleet data, PTT command, and volume set command. This data is contained within the control head code plug or the control head switches and the PTT switch. The request for data to the control head and the reply are performed via two serial data links operating at 4800 baud. A separate clock signal, developed by the 76.8 kHz serial data clock, is divided by 2 before being applied to the microprocessor.This clock signal controls the speed at which serial data is transmitted on the serial data lines. The output of the 76.8 kHz oscillator is also fed to the control head UART (universal asynchronous receiver/transmitter) via the control cable and a clock buffer, U10D.

3.3.3.2 Serial Data Clock

The 76.8 kHz serial data clock consists of a free running astable multivibrator, U6C, and a divide by 2 counter, U7A. The frequency determining components of the free running multivibrator are R27 and C8. When the voltage across C8 rises above a threshold voltage determined by R28 and R29, the output at U6C-13 snaps low and triggers U7A. The low output at U6C-13 discharges C8 through R27 and when the voltage across C8 goes below the threshold voltage determined by R28 and R29, the output at U6C-13 snaps high. This pattern continues as long as power is applied to the radio. The output of U6C toggles U7A, the $\overline{Q}$ output of which passes through U8A to pin 10 of U1. The $\overline{Q}$ output of U7A is one half the 76.8 kHz output of U6C or 38.4 kHz. The UART in the control head is driven by the 76.8 kHz output of U6C, providing synchronism of the serial data flow.

3.3.3.3 Serial Data Transmitter

The serial data request to the control head is passed through a serial data transmitter circuit consisting of three inverters, U10A, U10B, and U10C. The three inverters provide a balanced differential output for the serial transmit data appearing at U1 pin 12. One side of the differential path is routed through only one inverter while the other side is routed through two inverters. Because of the second inversion, the two output paths are always 180° out of phase with each other creating true differential data at the output of the inverters. The output of the serial data transmitter circuit swings between 5.4 and 10.5 volts peak-to-peak. Figure 4 shows the 8-bit data format along with the idle condition and start and stop bit format. No parity bit is used in the 8-bit data.

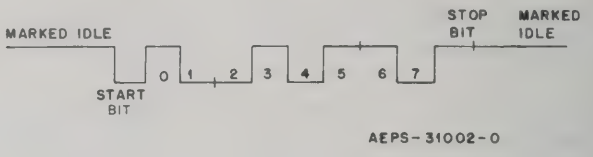


Figure 4.
Serial Data Transmitter Communications Format

3.3.3.4 Watchdog Timer Circuit

A separate "tickle pulse" output from the serial data transmit circuit (U10B pin 2) is fed to the gate of CR1 in the watchdog timer circuit. The "tickle pulses" are basically the serial transmit data through U10B which recur approximately every 12 ms. These pulses fire CR1 as they occur keeping U6D pin 6 low and the output of U6D high for normal operation. If the "tickle pulses" are not present for approximately 175 ms for any reason (microprocessor lock-up for example), C5 will discharge through R13 and allow U6D pin 6 to reach a voltage level above that on U6D pin 7. This causes the output of U6D to go low and reset the microprocessor U1. When the output of U6D goes low, C5 will again start charging again causing the same events to repeat as in system initialization. Assuming the microprocessor fails to initialize again, U6D will become a free running oscillator at approximately 4 Hz resetting the microprocessor and initializing it again and again until either proper operation is obtained or the radio set is shut off.

3.3.3.5 Serial Data Receiver

The serial data receiver consists of U6A and associated components. The serial data from the control head is routed into U6A which refreshes the differential balanced data on the receive link and converts it to an unbalanced signal of proper amplitude to drive the microprocessor input at pin 11. Resistor R7 is connected between U6A-14 and U6A-9 for hysteresis purposes to prevent the comparator from oscillating during slow-input transitions.

3.3.4 Searching For Control Channel

After initialization, the microprocessor interrogates the control head and retrieves the data for the four control channel frequencies, the system ID, and the fleet and subfleet assignments stored in the code plug. This data is stored in RAM, an integral part of the microprocessor chip. The microprocessor now generates an 8-bit parallel address on the address/data bus and latches this address in the address latch (U3) when the

address strobe line at U1-39 goes high. Once the address is latched in U3, the 8-bit address appears at the output of U3 and is routed to ROM, U2. A higher order address, directly from the microprocessor (U1 pins 26 through 29), is also applied to ROM U2. When the CS1 input at U2-20 is low and the CS2 input at U2-21 is high, the instruction contained at the address applied to the ROM is outputted on the D0 through D7 data output lines. This instruction is read by the microprocessor. The microprocessor acts upon the instruction just received and uses the data stored in RAM to calculate the address and data bits required to cause the synthesizer to operate on the first control channel receive frequency.

The address and data bits appear on the address/data bus as seven 7-bit words. The first three bits are address and the remaining four bits are data. All seven bits are latched into U3, however only the first three bits, A0 through A2, are applied to U4. The remaining 4 bits of data are applied directly to U4 via the address/data bus. These 7-bits of data represent the first of seven 7-bit bytes that are transferred to the synthesizer to select the first listening channel in a search for the control channel.

At this time the E output at U1-40 and the A14 output at U1-23 go high and the $\overline{W}$ output at U1-38 goes low. This causes the output of U5B to go high which is transferred to pin 11 of U4 through U5D. This action prepares U4 to latch in the address and data presented at its input and primes U7B, the strobe pulse stretcher flip-flop. When the E output at U1-40 goes low, the $\overline{W}$ output at U1-38 goes high causing two events to occur. First, the E output at U1-40 going low toggles U7B. The propagation delay through U5B holds the J input of U7B high long enough to clock the high into the flip-flop causing the Q output (U7B-12) to go high. As the output of U5B goes low, the address and data applied to the input of U4 is latched into U4 via U4-11.

A $\overline{\text{SYN SYNC}}$ input at J601 pin 9 is routed to U5C. This low going signal in coincidence with an output from U4 pin 19 provides a negative going input to U1-4 which tells the microprocessor that the synthesizer is ready to accept data.

Approximately 1.1 us later, the E output at U1-40 toggles low again. This toggles U7B again causing its Q output to go low. The high to low transition at the Q output of U7B is routed to the synthesizer through J601 pin 4. This causes the divider (U602 in the synthesizer) to accept the address and data latched into U4 and appearing at its output.

The microprocessor continues to provide addresses and data on the address/data bus that are latched into U3 and/or provided to U4 until all 7 bytes are transferred to the synthesizer. This data represents the first operating frequency and the command to go to that frequency for the synthesizer.

When this is completed, the microprocessor listens to the frequency channel just selected looking for the control channel. Whatever is on the channel just selected is routed through the center slicer on the filter board and applied to the input of U6B on the personality board. Comparator U6B refreshes the differential balanced data and converts it to an unbalanced signal of proper amplitude to drive the microprocessor input at pin 8. The filter board and center slicer are operating in the high speed data mode during this time.

If the listening channel just selected contains a background word and an OSW, the microprocessor will synchronize to the data presented on the channel and wait for the ID contained in the background word and OSW (the ID recurs every two seconds in the background word). If the ID matches the ID retrieved from the code plug, the radio will remain locked on this channel. No further data will be transferred to the synthesizer until a frequency change is required.

If the channel just selected contains only noise or does not contain the proper ID in the background word, the microprocessor will repeat the entire sequence, i.e. retrieve the channel 2 information from the code plug, produce and transfer the 7 bytes of information to the synthesizer required to operate on channel 2, listen for the proper ID on the background word, and either lock on that channel if the ID is correct or repeat the process for channel 3. The same process is repeated again for any remaining channels until the proper control channel is located.

Basically, all frequency selection follows the same process. The only difference is what initiates the channel change command, which may be either the operator by initiating a call or by a command from the base station.

3.3.5 Receiving a Call

When a mobile radio receives a call, the background word and OSW on the control channel contains information that directs the mobile radio to change frequency to a vacant voice channel. The microprocessor recognizes this command and initiates the transfer of the 7 bytes of data to the synthesizer required to change the synthesizer frequency. The microprocessor now listens to the handshake word present on the voice channel. The microprocessor first tries to read the handshake word using the high speed filter, if the data is unintelligible, it will switch to the low speed filter and try to read the data again. If intelligible data is obtained, the microprocessor checks to see if the fleet and subfleet data contained in the handshake word match what is stored in the control head code plug. If intelligible data is still not obtained, the microprocessor will revert to the control channel and try the sequence again as directed by the control channel background word and OSW.

Once intelligible data and a match between the data in the handshake word and the data in the code plug is obtained, the AUDIO ENABLE output at U1-14 goes high. This high output is inverted by U9D and routed to the audio section of the trunked personality board. Here it opens the audio gate to allow receive audio to be heard in the radio speaker.

3.3.6 Making a Call

When the mobile operator depresses his PTT switch, the mobile unit (if it is receiving the control channel at this time) will key up and send a request for service (ISW) on the control channel. The ISW is sent in a precise time slot relative to the OSW time frame. The request ISW contains information about the mobile ID, fleet and subfleet to which it is attached, and the purpose for which the channel is requested (group, system, individual call). The ISW is 78 bits long and sent at 3600 bps for a total length of 23 ms. Operation is as follows:

When the PTT is depressed on the microphone, a PTT command is routed to the UART on the control head and a $\overline{\text{SERVICE PTT}}$ signal is routed to the personality board as an input to Q9 in the keyed +9.4 V switch circuit. The $\overline{\text{SERVICE PTT}}$ signal to Q9 prevents an automatic shut down of the keyed +9.4 V switch circuit. The shut down feature prevents the mobile from transmitting for more than ten seconds in case of a program failure in the microprocessor.

Transistor Q9 acts like a diode to prevent capacitor C17 from charging when the $\overline{\text{SERVICE PTT}}$ input is low. If Q10 is turned off by a low $\overline{\text{PA KEY}}$ at U1-18 and the $\overline{\text{SERVICE PTT}}$ is high, C17 will start charging through R47 and CR7. The time constant is such that approximately 10 seconds after the collector of Q10 goes high, C17 will have charged sufficiently to fire the gate of Q8. When Q8 conducts, CR9 conducts pulling the collector of Q10 to ground through CR10. This action shuts off Q6 and Q7, disabling the keyed +9.4 V output. Resistor R51 connected to the anode of CR9 supplies enough holding current to CR9 to keep it conducting after it is turned on. Once turned on, Q8 and CR9 remain conducting until the radio set is turned off and turned on again.

The PTT command routed to the UART on the control head is read by the microprocessor during its normal routine of checking control head status. Once the PTT command is recognized by the microprocessor, the $\overline{\text{PA KEY}}$ output at U1-18 goes low for 23 ms. This causes the transmitter to key up for 23 ms and transmit a request for service (inbound signaling word, ISW). The ISW contains information about the mobile ID, the fleet and subfleet to which it is attached, and purpose for which the channel is requested (group, system, or individual call). When the central controller recognizes the request, it directs the mobile to a particular voice channel via the OSW.

The microprocessor recognizes the channel change information in the OSW, transfers the 7 bytes of data to the synthesizer to change frequency, and listens for the handshake word on the voice channel. The microprocessor first tries to read the handshake word using the high speed filter, if the data is unintelligible, it will switch to the low speed filter and try to read the data again. If intelligible data is obtained, the microprocessor checks to see if the fleet and subfleet data contained in the handshake word match what is stored in the control head code plug.

If a match is obtained, the microprocessor will key up the radio transmitter and send an 80 ms burst of 1800 Hz acknowledge tone. Transmitter key-up occurs as follows.

The $\overline{\text{PA KEY}}$ output at U1-18 goes low which turns off PA key switch, Q10. This allows the collector of Q10 to be pulled high through R43 which turns on Q6. When Q6 turns on, Q7 becomes saturated producing the keyed +9.4 V output which supplies the operating power to the power control circuit on the common circuits board keying up the transmitter. Since the $\overline{\text{SERVICE PTT}}$ to Q9 is also low (PTT button depressed on the microphone) the 10 second timer (Q8, Q9, CR9) is disabled.The transmitter will remain keyed up until the PTT button is released on the microphone.

The 1800 Hz acknowledge tone is produced at U1 pin 9 where it is routed through J302-13 to the filter board. After filtering, the acknowledge tone is transmitted. The $\overline{\text{XMIT AUDIO ENABLE}}$ output at U1-16 remains high during transmission of the acknowledge tone to prevent microphone audio from interfering with the tone signal.

At the end of the 80 ms acknowledge transmission, the $\overline{\text{XMIT AUDIO ENABLE}}$ output at U1-16 goes low enabling the microphone audio circuits. Simultaneously, the LOW SPEED SELECT output at U1-17 goes high which selects the low speed filter on the filter board, and a 105.88 Hz connect tone at U1-9 is transmitted along with the voice message.

When the mobile PTT is released, the $\overline{\text{XMIT AUDIO ENABLE}}$ at U1-16 goes high disabling the microphone audio circuits and the mobile transmits 200 ms of disconnect tone. The disconnect tone is 163.64 Hz and output from U1 at pin 9. At the end of the disconnect tone period, the $\overline{\text{PA KEY}}$ at U1-18 goes high turning off the transmitter. The mobile will now listen for any reply. If the reply occurs within one second after the end of the disconnect tone, the reply will be on the same voice channel. If the reply occurs later, the mobile will revert to the control channel and be assigned a new voice channel for the reply.

3.3.7 Alert Tone Generation

Six different radio tones indicate unique operational situations. These are:

- Busy system indication
- Automatic call-back tone
- Time-out-timer alert tone
- Failsoft indication
- Talk permit tone
- Volume set tone

All these tones except the failsoft indication are generated by the microprocessor on the trunked personality board. The tones are outputted at U1-13 and routed through J1001 to the control head where they are applied to the volume control. The output of the volume control is routed back to the trunked personality board audio section where the tones are amplified and routed back to the radio speaker. When any of these tones are produced, the REC ENABLE output at U1-15 is high to prevent any receive audio from being mixed with the tones.

3.4 AUDIO SECTION THEORY

3.4.1 General

The audio section of the trunked personality board consists of an audio enable switch, four filter stages, a class B audio driver stage, a push-pull audio predriver stage, and push-pull audio output stage. Refer to diagram EEPS-30115 for details during the following discussion.

3.4.2 Theory of Operation

The audio enable switch consists of transistor Q441 and associated components. When the AUDIO ENABLE input to Q441 goes low, Q441 is turned off. This allows receive audio to enter the high pass filter stages U440A, U440B, and U440C. The high pass filter has a low frequency cutoff around 300 Hz which prevents the low speed handshake, connect tone, or disconnect tone from being heard in the radio speaker.

Audio gate transistor, Q450, turns on simultaneously with Q441 since it operates off the same input signal. This allows the output of the filter stages to pass to the de-emphasis network, U440D. The network provides approximately 6 dB per octave de-emphasis to compensate for the 6 dB per octave pre-emphasis added by the base station transmitter. The output of the de-emphasis circuit is routed into the input of the class B audio driver stage, U441.

The class B audio driver stage provides a push-pull output which is used to drive the audio output predrivers, Q443, Q444. Although Q443 and Q451 are a matched pair as are Q444 and Q452, only Q443 and Q444 are amplifiers. Q451 and Q452 are used as temperature compensation devices for Q443 and Q444 respectively. Notice that the base-collector junctions of Q451 and Q452 are shorted externally and that the base-emitter junctions are used as diodes.

A separate audio output switch circuit is used to lower the standby current drain of the audio output predrivers. The switch circuit consists of Q446 and Q447 and is controlled by two inputs: AUDIO ENABLE and AUDIO PREDRIVER ENABLE. If either of these two signals go low, the audio output switch circuit is enabled. This causes Q446 to turn on driving Q447 into saturation. With Q447 saturated, the current through Q451 and Q452 is increased which provides normal operating bias for Q443 and Q444.

The output of the audio predrivers is used to drive the audio output transistors Q448 and Q449. The audio output transistors drive transformer T440 which has two secondary windings. One winding provides an 8-ohm output that is used to drive the radio loud speaker. The other winding provides feedback to the input of U441 and to the emitter junction of Q443 and Q444. This feedback improves linearity and response of the audio output signal.

3.5 TROUBLESHOOTING PROCEDURE

The trunked personality board troubleshooting procedure is included in the General Maintenance/ Troubleshooting Section of this manual.

4. TRUNKED FILTER BOARD THEORY OF OPERATION

4.1 GENERAL
(Refer to schematic diagram EEPS-29541.)

The TRN4274A Trunked Filter Board is comprised of the following major functional elements:

- Low-speed (low pass) seven-pole Butterworth filter with a corner frequency of 200 Hz.
- High-speed (low pass) seven-pole Bessel filter with a corner frequency of 2050 Hz.
- An analog multiplexer (U301) which acts as a two pole-four position switch.
- Transfer "FET" gates U302A, U302C, U302D utilized to implement data, and audio routing.
- A low-speed transmit data buffer attenuator Q301, to obtain a 3:1 deviation ratio between high speed and low speed data.
- Data recovery center slicer circuitry.

4.2 LOW SPEED FILTER

This is a seven-pole, low pass Butterworth filter with a corner frequency of 200 Hz that is used to:

- Remove from the received signal any high frequency noise that may have been introduced by the transmission process.
- Remove any voice energy from the low speed data. In this mode it is called a "voice blocking filter" since it prevents any voice energy from causing any distortion to the received data.
- Attenuate harmonics of the subaudible connect tone (105 Hz) and disconnect tone (164 Hz) when they are transmitted. This prevents a listening mobile from hearing any objectionable low frequency tones.

Operational amplifiers U303A, B, and C, are used as the active elements in the filter with resistors R314, R317, and R320 providing temperature compensation. The amplifiers are operated as unity gain devices.

4.3 HIGH SPEED FILTER

This is a seven-pole, low pass Bessel filter with a corner frequency of 2050 Hz that is used to:

- Remove from the received data any high frequency noise that may have been introduced by the transmission process.
- Serve as a splatter filter during transmission of high speed data to attenuate any harmonics whose frequency are greater than 2050 Hz.

Operational amplifiers U303D, U304A, and U304B are used as the active elements in the filter with resistors R324, R327, and R330 providing temperature compensation. The amplifiers are operated as unity gain devices.

4.4 ANALOG MULTIPLEXER U301

This device is used to route receive and transmit data through the proper filter at the proper time as directed by the microprocessor on the personality board. The multiplex is the equivalent of a two-pole-four-position switch. The multiplexer's state is controlled by the A and B inputs on pins 10 and 9 respectively according to the following table:

A	B	Mode	Function
LO	LO	0	Receive Low Speed Data
HI	LO	1	Receive High Speed Data
LO	HI	2	Transmit Low Speed Data
HI	HI	3	Transmit High Speed Data

In the above table, the "LO" is a voltage less than 1 volt and the "HI" is a voltage greater than 9 volts.

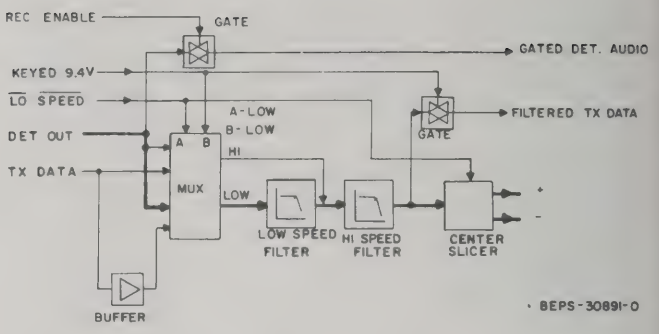


Figure 5. Mode 0, Receive Low Speed Data

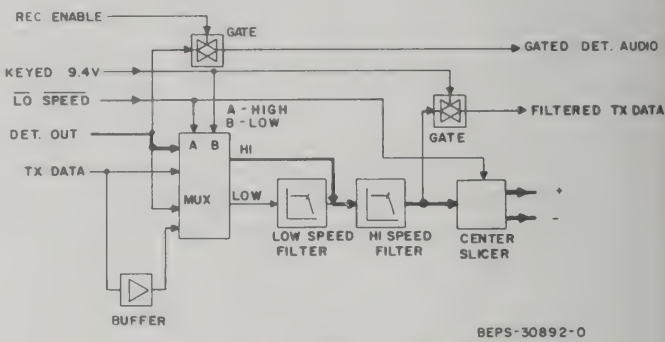


Figure 6. Mode 1, Receive High Speed Data

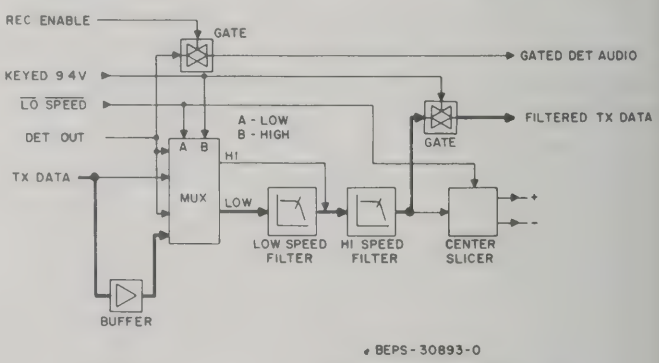


Figure 7. Mode 2, Transmit Low Speed Data

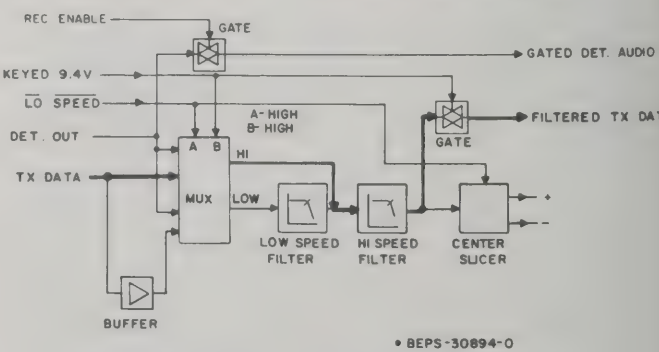


Figure 8. Mode 3, Transmit High Speed Data

4.5 TRANSFER GATES (U302A, U302C, U302D)

These field effect transistor elements (FET's) implement the gated switching functions performed by the filter board. U302A is utilized to switch the audio output from the filter board to the trunked personality

board; gate U302C is used to change to the appropriate time constant needed between the low and high speed receive function for the center slicer circuit; and lastly, "FET" U302D controls the passage of filtered transmitted high speed (3600 baud) or low speed (150-300 baud) data to the modulator.

4.6 LOW SPEED TX DATA BUFFER-ATTENUATOR

In order to provide a 3:1 deviation ratio between high speed data (i.e. inbound signal word) and low speed data (i.e. subaudible connect tone) NPN transistor Q301 is configured as a voltage follower and attenuator. The biasing and input resistors R307, R308, and R309 are used to reduce the 5 volt p-p square wave input to approximately 1 volt p-p. Since the voltage gain through an emitter follower is typically .99, almost all of the signal seen at the base of Q301 is also seen at the emitter across R309.

The impedance transformation also typical of emitter followers provides a low impedance source to drive the filter stages.

4.7 FUNCTIONAL DESCRIPTION OF CENTER SLICER

The center slicer converts the analog filtered data from the receiver into a square digital bit stream that is fed to the processor for decoding. The output of the center slicer exits the board on pin 6 and 7 of J301.

The conversion process would be relatively simple if all the received data bits had the same amplitude and they did not contain any average dc voltage. See Figure 9A as an example. If this data is fed to U6B pin 4 (see Figure 10) while a dc source equal to half of the bit voltage is fed to U6B pin 5, the comparator will provide at U6B pin 2 a digital output that is the equivalent of the receive analog data.

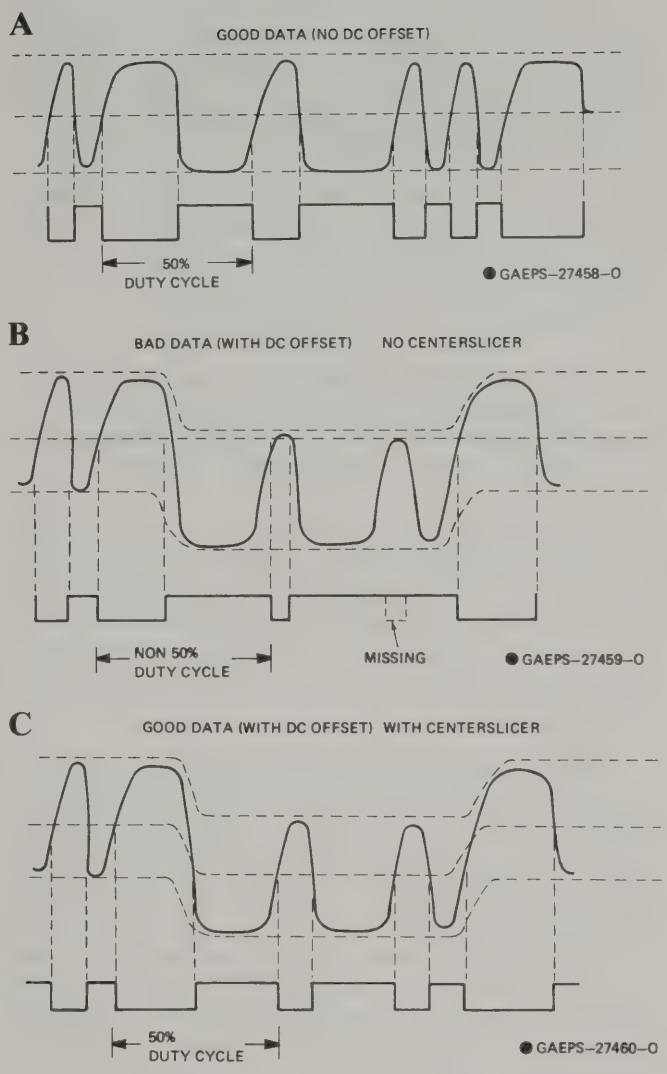


Figure 9. Data Recovery Example

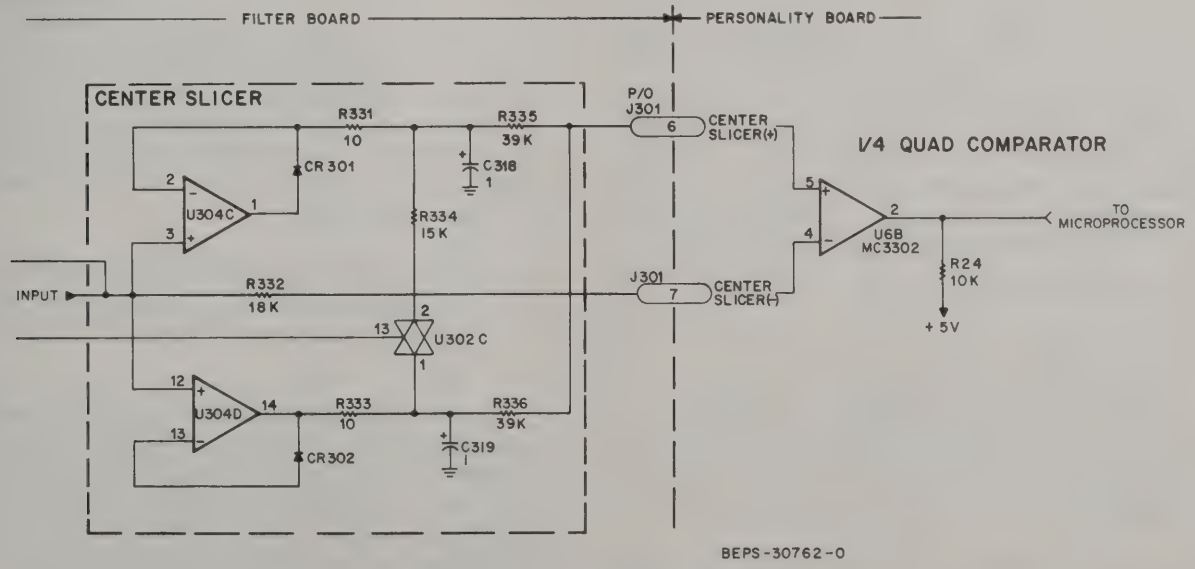


Figure 10. Center Slicer Circuit

If the data bits have different amplitudes as could happen under noisy conditions or if the data contains a dc step as could happen while changing from an on frequency channel to an off frequency channel (see Figure 9B), then the recovery process is not a simple one.

Referring to Figure 9B again, it can be seen that if the comparator's threshold point is tied to a fixed voltage, this voltage can occur at any point in a fluctuating bit stream, resulting in missing bits and/or skewed data (1's wider or narrower than 0's).

The center slicer compensates for any shift in the average dc value for any variations in data amplitude by shifting the comparator's reference input so that it lies exactly halfway between the serial data bit peaks.

U304C and CR301 in Figure 10 form an ideal diode which, along with R331 and C318 form a positive peak detector. C318 charges to the maximum peak value of the data with R331 serving to limit the charge current. Likewise a negative peak detector is formed from U304D, CR302 and capacitor C319 with R333 serving to limit charge current.

After establishing the two reference lines, one at the top and one at the bottom of the received data which change in level with the data, a reference line is generated through the center of the data. R335 and R336 sum up the two peak voltages, take their average by dividing the total by two, and generate a center line that varies in accordance with the data amplitude and dc voltage present. This center reference line is applied to U6B pin 5 and the receive data is applied to U6B pin 4. The recovered digital bit stream appears and an output at U6B pin 2.

Also included in the center slicer is an FET transmission gate U302C and resistor R334. These two components are used to change the time constant of the peak detectors. In able to respond to the high speed data without "over integrating" the pulses, the time constant is made shorter in modes 1 and 3 by putting a logic high (>9 volts) on J301-9. The time constant is made shorter so that the reference line generated by the center slicer more closely represents the voltage midway between successive data bits. If the time constant were too long, the reference line would be following data that had already passed through the circuit. Therefore the FET gate is on in modes 1 and 3 and off in modes Ø and 2.

4.8 SIGNALING DEFINITIONS

4.8.1 Receive Mode

(Continue to refer to diagram EEPS-29541.)

Receive low speed data includes the following:

- low speed handshake connect word @150 baud; on voice channel.
- low speed disconnect word @300 baud; on voice channel.

Receive high speed data includes:

- background data word @3600 baud; on control channel
- outbound signaling word (OSW) @3600 baud; on control channel
- high speed handshake @3600 baud; on voice channel.

All of the above signals enter the trunked filter board at the "DET OUT" terminal J301-8. The control of their time sequence and routing is a direct function of the MC6803 microcomputer located on the trunked personality board. The implementation function of routing these signals through the appropriate filters and center slicer stages is performed by the circuitry on the filter board and is described in section 4.9.

The filtered and recover data outputs in receive mode appears at J301-6 center slicer (+) and J301-7 center slicer (-).

The "RCV ENBL" signal on J301-3 controls the gating of the detector audio via U302A out to the trunked personality board.

4.8.2 Transmit Mode

Transmit low speed data includes:

- connect tone @105 Hz on voice channel
- disconnect tone @163 Hz on voice channel.

Transmit high speed data includes:

- inbound signaling word (ISW) @3600 baud on control channel
- acknowledge word @1800 Hz on voice channel.

All the above signals enter the trunked filter board at the "TX Data" input on J301-13. The control of their time sequence and routing is a direct function of the MC6803 microcomputer located on the trunked personality board. The implementation function of routing these signals through the appropriate filter stages is performed by the circuitry on the filter board and is described in section 4.4.

4.9 DESCRIPTION OF DATA ROUTING PERFORMED BY FILTER BOARD (Continue to refer to diagram EEPS-29541 attached.)

Analog multiplexer U301 is used to route receive and transmit data through the proper filter at the proper time as directed by microprocessor U1 on the personality board. The multiplexer is the equivalent of a two-pole-four-position switch. The multiplexer's state is controlled by the A and B inputs on pins 10 and 9 respectively according to the following table:

A	B	Mode	Function
LO	LO	Ø	Receive Low Speed Data
HI	LO	1	Receive High Speed Data
LO	HI	2	Transmit Low Speed Data
HI	HI	3	Transmit High Speed Data

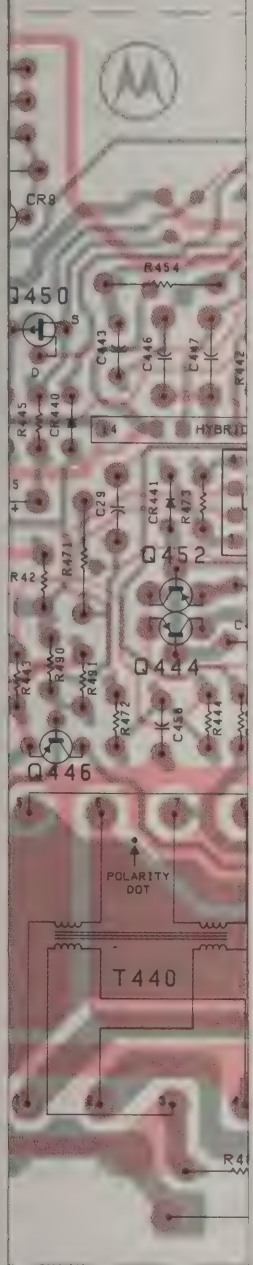
In the above table, the "LO" is a voltage less than 1 volt and the "HI" is a voltage greater than 9 volts.

4.10 TROUBLESHOOTING PROCEDURE

The trunked filter board troubleshooting procedure is included in the General Maintenance and Troubleshooting Section of this manual.

DESCRIPTION

ed: ± 5%; 1/4 W:
rwise stated



REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U10	51-84561L03	type M74LS04
U440	51-83629M06	type M4136
U441	51-83629M02	type M3321
	mechanical parts	
	26-83498M01	HEATSINK, audio
	42-82660M05	CLIP, retainer
	55-84300B03	HANDLE, short
	9-84924E01	SOCKET, (U2)
	3-10905A05	SCREW, machine 3.0 x 0.5 x 8"; 2 used
	4-84180C01	WASHER, shoulder; 2 used
	14-83820M02	INSULATOR, transistor; 2 used
	3-83741M01	SCREW, tapping; 3.0 x 8"; 2 used
	3-10943D32	SCREW, tapping; 3.5 x 0.6 x 16"
	42-83503M01	RETAINER; 7 used
	3-10943D29	SCREW, tapping; 3.5 x 0.6 x 8"; 4 used
	3-10943D34	SCREW, tapping; 3.5 x 0.6 x 25"; 2 used
	75-00838826	BUMPER; 2 used
	4-84345A12	WASHER, ins.; 1 used
	84-83450M03	PC BOARD, personality
	42-82660M03	CLIP (U2)
	75-82230B14	PAD (U2)

notes
1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
2. Transistors Q443 and Q451 are a matched pair and must be replaced as an assembly.
3. Transistors Q444 and Q452 are a matched pair and must be replaced as an assembly.

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ohm

ircuit: (see note)
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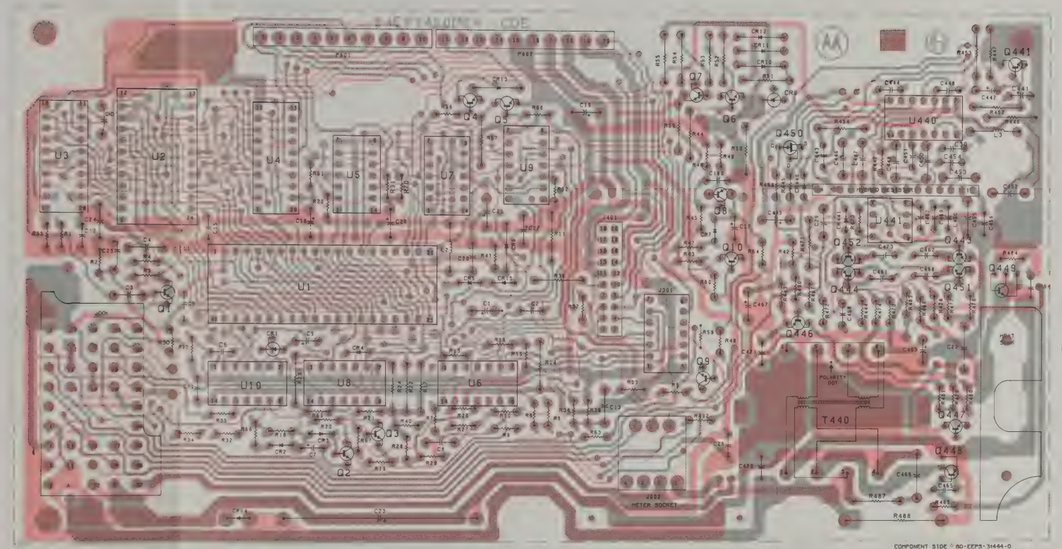
Trunked Personality Circuit Board Detail and Parts List
Motorola No. PEPS-29670-B
1/15/81-PHI



SHOWN FROM SOLDER SIDE

parts list

TLN2237A Personality Board — PL-7027-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 20%; 100 V: unless otherwise stated
C1	23-82747L20	100; 25 V
C2	21-11015A07	.01 + 80-20%
C3	21-84484B21	650 pF ± 5%; 300 V
C4	8-84637L37	0.1 ± 5%
C5	23-11013D51	1 ± 20%; 20 V
C6	21-11015A07	.01 ± 80%
C7	23-11013E57	10; 25 V
C8	21-82537B30	240 pF ± 3%; 500 V
C9, C10	21-82610C43	62 pF ± 5%; NPO
C11, 12	21-11015A07	.01 + 80-20%
C13	8-84637L37	0.1 + 5%
C15	21-11015A07	.01 + 80-20%
C16	23-84538G29	47; 10 V
C17	23-11013E57	10 ± 20%; 25 V
C18	21-11015A07	.01 + 80-20%
C19, 20, 21	23-84538G29	47; 10 V
C22	8-84637L22	0.22 ± 10%
C23	23-83210A08	100; 25 V
C24	8-84637L37	0.1 ± 5%
C25	21-82373C02	.05; 25 V
C26	21-11015B05	220 pF ± 10%
C27, 28	23-84538G29	47; 10 V
C29	21-82372C04	.05; 25 V
C30	21-11014H19	5.6 pF
C441, 442	23-11013D51	1; 20 V
C443	8-11017A02	.0015 ± 5%; 50 V
C444	21-11014H40	43 pF ± 5%
C445	23-84538G29	47; 10 V
C446, 447	8-84637L37	0.1 ± 5%
C448	21-11014H40	43 pF ± 5%
C449, 450	8-84637L37	0.1 ± 5%
C451	21-11014H40	43 pF ± 5%
C452, 453	8-84637L37	0.1 ± 5%
C454	21-11014H40	43 pF ± 5%
C455	8-84637L37	0.1 ± 5%
C456	8-11017A06	.01 ± 5%; 50 V
C457	21-11015B05	220 pF ± 10%
C458	23-11013C56	22; 15 V
C460	8-11017A02	.0015 ± 5%; 50 V
C461, 462	21-11015B05	220 pF ± 10%
C463	23-82747L01	330 + 100-10%; 20 V
C464, 465	21-11015B05	220 pF ± 10%
C466	9-84637L22	0.22 ± 10%
C467	23-82747L06	220 ± 10%; 25 V
C468 thru 471, 473	21-11015B05	220 ± 10%
		diode: (see note 1)
CR1	48-869577	silicon controlled rectifier
CR2	48-84616A01	silicon
CR3	48-83654H01	silicon
CR4, 5, 6, 7	48-84616A01	silicon
CR9	48-869577	silicon controlled rectifier
CR10, 11, 12	48-83654H01	silicon
CR13	48-84616A01	silicon
CR14	48-82525G02	silicon
CR15	48-84616A01	silicon
CR440, 441	48-83654H01	silicon
		hybrid:
HY400	51-82142K07	resistor network
		connector, receptacle:
J1	1-80726D99	power; includes:
	28-83485A01	male, 37 contact
	32-80219B01	gasket
	76-84069B02	ferrite bead: 39 used
J2	9-84207B01	female; 7-contact (metering socket)
J301	9-84224E05	female; 14-contact
J401	28-83603A01	male; 20-pin
J601, 602	28-82647K02	male; 10-pin
		coil, rf:
L1	24-82723H07	choke: 10 uH
L2	24-83961B02	5 turns; coded GRN
L3	24-83961B07	2 turns; coded YEL
		transistor: (see note 1)
Q1	48-869570	NPN; type M9570
Q2 thru 5	48-869642	NPN; type M9642
Q7	48-869619	PNP; type M9619
Q8	48-869673	uni-junction; type M9673
Q9	48-869570	NPN; type M9570
Q10	48-869642	NPN; type M9642
Q441	48-869642	NPN; type M9642
Q443, 451	01-80726D63	see note 2
Q444, 452	01-80726D64	see note 3
Q446	48-869643	PNP; type M9643
Q447	48-869642	NPN; type M9642
Q448	48-84413L07	PNP; type M9807
Q449	48-84413L06	NPN; type M9806
Q450	48-869705	field-effect

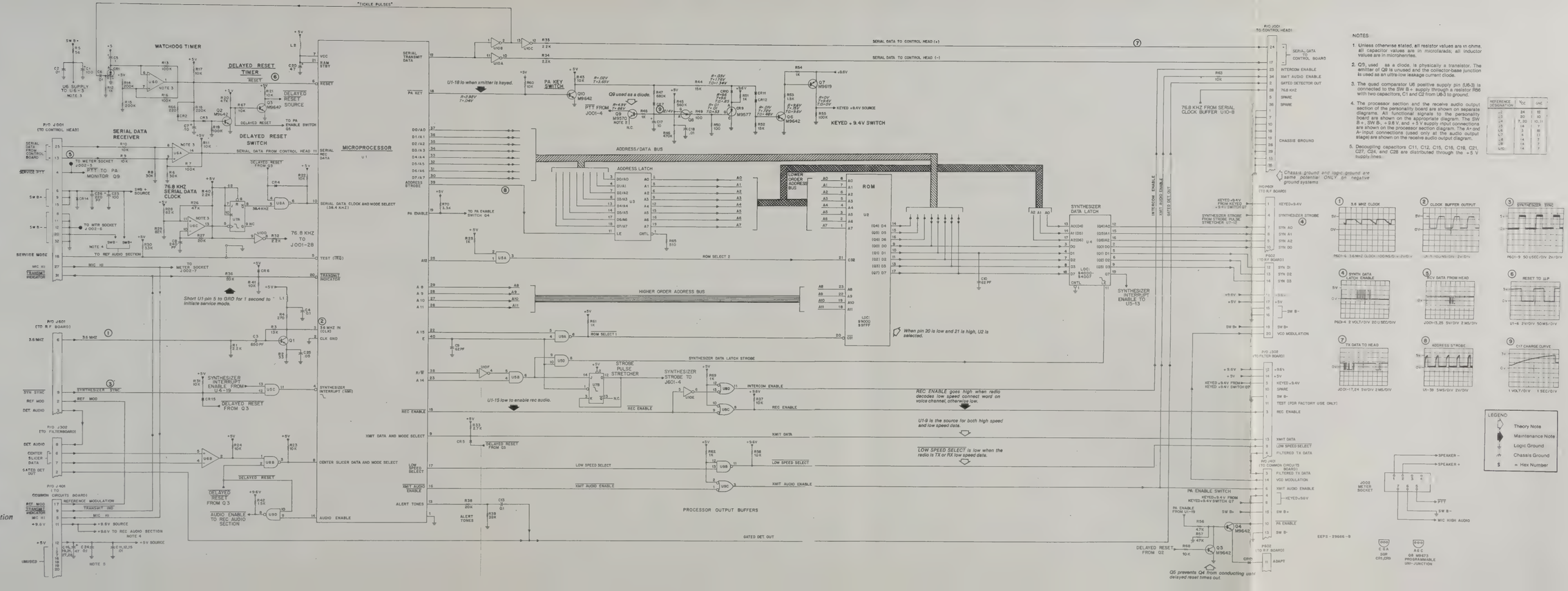
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-11009E57	2.2k
R2	6-11009E13	33
R3	6-11009E76	13k
R4	6-11009E35	270
R5	6-11009E19	56
R6	6-11009E84	30k
R7	6-11009E97	100k
R8	6-11009E84	30k
R9, 10, 11	6-11009E73	10k
R12	6-11009E49	1k
R13	6-11009E97	100k
R14, 15	6-11009B05	200k
R16	6-11009E97	100k
R17	6-11009E73	10k
R18	6-11009F06	220k
R19	6-11009E97	100k
R20	6-11009E89	47k
R21 thru 24	6-11009E73	10k
R25	6-11009E49	1k
R26	6-11009E89	47k
R27	6-11009E80	20k
R28, 29	6-11009E95	62k
R30	6-11009E61	3.3k
R31	6-11009E73	10k
R32	6-11009E57	2.2k
R33	6-11009E59	2.7k
R34, 35	6-11009E57	2.2k
R36	6-11009E80	20k
R37	6-11009E73	10k
R38	6-11009E80	20k
R39	6-11009E87	39k
R40	6-11009E57	2.2k
R41	6-11009E73	10k
R42	6-11009E53	1.5k
R43	6-11009E73	10k
R44	6-11009A77	15k
R45	6-11009F16	560k
R46	6-11009F14	470k
R47	6-11009F16	560k
R48	6-11009E49	1k
R49, 50	6-11009E25	100
R51	6-11009E49	1k
R52	6-11009E77	15k
R53	6-11009E53	1.5k
R54	6-11009E49	1k
R55	6-11009A97	100k
R56	6-11009E65	4.7k
R57	6-11009A89	47k
R58	6-11009A73	10k
R60	6-11009E73	10k
R61, 62	6-11009E49	1k
R63	6-11009E73	10k
R64	6-11009E57	2.2k
R65	6-11009E42	510
R66	6-11009E33	220
R67, 68	6-11009E73	10k
R69	6-11009E49	1k
R70	6-11009E61	3.3k
R442	6-11009E33	220
R443	6-11009E01	10
R444	6-11009E73	10k
R445	6-11009E97	100k
R446	6-11009A59	2.7k
R447	6-11009B06	220k
R452	6-11009A82	24k
R453, 454	6-11009A91	56k
R470	6-11009E33	220
R471	6-11009A97	100k
R472	6-11009E49	1k
R473	6-11009E59	2.7k
R474	6-11009E73	10k
R476, 477	6-11009E01	10
R478	6-11009E15	39
R479	6-11009E89	47k
R480	6-11009E83	27k
R481	6-11009E89	47k
R483	6-11009E01	10
R484, 485	6-11009E65	4.7k
R486	6-11009E77	15k
R487	6-11009E01	10
R488	17-C82350A14	variable; .08 ohm
R489	6-11009F06	220k
R490	6-11009E89	47k
R491	6-11009E73	10k
R492	6-11009E89	47k
		transformer:
T440	25-84083B04	pri: res. 0.5 ohm sec: res. 0.8 ohm
		integrated circuit: (see note)
U1	51-83625M08	type MC6803
U2	TRN-4276A	ROM
U3, 4	51-83627M03	type M74LS373
U5	51-84561L07	type M74LS08
U6	51-84371K74	type MC3302
U7	51-82909M02	type M74LS73
U8, 9	51-83627M04	type M74LS26

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
U10	51-84561L03	type M74LS04
U440	51-83626M08	type M4136
U441	51-83629M02	type M3321
		mechanical parts
	26-83498M01	HEATSINK, audio
	42-82660M05	CLIP, retainer
	55-84300B03	HANDLE, short
	9-84924E01	SOCKET, (U2)
	3-10905A06	SCREW, machine 3.0 x 0.5 x 6"; 2 used
	4-84180C01	WASHER, shoulder; 2 used
	14-83620M02	INSULATOR, transistor; 2 used
	3-83741M01	SCREW, tapping; 3.0 x 6"; 2 used
	3-10943D32	SCREW, tapping; 3.5 x 0.6 x 16"
	42-82503M01	RETAINER; 7 used
	3-10943D29	SCREW, tapping; 3.5 x 0.6 x 8"; 4 used
	3-10943D34	SCREW, tapping; 3.5 x 0.6 x 25"; 2 used
	75-20638B28	BUMPER; 2 used
	4-84345A12	WASHER, ins.; 1 used
	84-82450M03	PC BOARD, personality
	42-82660M03	CLIP (U2)
	75-82230B14	PAD (U2)

notes

1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
2. Transistors Q443 and Q451 are a matched pair and must be replaced as an assembly.
3. Transistors Q444 and Q452 are a matched pair and must be replaced as an assembly.

Trunked Personality Circuit Board Detail and Parts List
Motorola No. PEPS-29670-B
1/15/81-PMH



Trunked Personality Board, Processor Section
Schematic Diagram
Motorola No. EEPS-29666-B
1/15/81-PHI

P/O J001
(TO CONTROL HEAD)

24 + SERIAL DATA TO CONTROL BOARD
17 -
23 INTERCOM ENABLE
34 XMIT AUDIO ENABLE
2 GATED DETECTOR OUT
28 76.8 KHZ
5 SPARE
36 SPARE
1
7
10
18
19 CHASSIS GROUND
26
29
33
35

Chassis ground and logic ground are same potential ONLY on negative ground systems.

NOTES:

1. Unless otherwise stated, all resistor values are in ohms; all capacitor values are in microfarads; all inductor values are in microhenries.
2. Q9, used as a diode, is physically a transistor. The emitter of Q9 is unused and the collector-base junction is used as an ultra-low leakage current diode.
3. The quad comparator U6 positive supply pin (U6-3) is connected to the SW B+ supply through a resistor R56 with two capacitors, C1 and C2 from U6-3 to ground.
4. The processor section and the receive audio output section of the personality board are shown on separate diagrams. All functional signals to the personality board are shown on the appropriate diagram. The SW B+, SW B-, +9.6 V, and +5 V supply input connections are shown on the processor section diagram. The A+ and A- input connections (used only at the audio output stage) are shown on the receive audio output diagram.
5. Decoupling capacitors C11, C12, C15, C16, C19, C21, C27, C24, and C28 are distributed through the +5 V supply lines.

REFERENCE DESIGNATION	V_{CC}	GND
U2	24	12
U3	20	10
U4	7, 20	10, 11
U5	14	7
U6	3	12
U7	4	11
U8	14	7
U9	14	7
U10	14	7

P/O P601
(TO R.F. BOARD)

1 KEYED+9.4V
4 SYNTHESIZER STROBE ④
7 SYN A0
8 SYN A1
5 SYN A2
10 SYN D0

P602
(TO R.F BOARD)

12 SYN D1
13 SYN D2
14 SYN D3
18 +9.6V
17 +5V
15 SW B-
16
19 SW B+
20 VCO MODULATION

① 3.6 MHZ CLOCK
5V
0V
P601-6 3.6 MHZ CLOCK 100 NS/DIV 2V/DIV

② CLOCK BUFFER OUTPUT
5V
0V
U1-3 100 NS/DIV 2V/DIV

③ SYNTHESIZER SYNC
5V
0V
P601-9 50 USEC/DIV 2V/DIV

④ SYNTH DATA LATCH ENABLE
5V
0V
P601-4 2 VOLT/DIV 20 U SEC/DIV

⑤ RCV DATA FROM HEAD
0V
J001-13,25 5V/DIV 2 MS/DIV

⑥ RESET TO µP
5V
0V
U1-6 2V/DIV 50 MS/DIV

P/O J302
(TO FILTER BOARD)

12 +9.6V
14 +5V
5 KEYED+9.4V
10 SPARE
1 SW B-
11 TEST (FOR FACTORY USE ONLY)
3 REC ENABLE
13 XMIT DATA
9 $\overline{\text{LOW SPEED SELECT}}$
4 FILTERED TX DATA

⑦ TX DATA TO HEAD
0V
J001-17,24 5V/DIV 2 MS/DIV

⑧ ADDRESS STROBE
5V
0V
U1-39 .5 MS/DIV 2V/DIV

⑨ C17 CHARGE CURVE
3V
0V
1 VOLT/DIV 1 SEC/DIV

P/O J401
(TO COMMON CIRCUITS BOARD)

3 FILTERED TX DATA
14 VCO MODULATION
6 XMIT AUDIO ENABLE
4 KEYED+9.6V
8
15 SW B+
10 $\overline{\text{PA ENABLE}}$
13 SW B-

J002 METER SOCKET
1 2 3 4
7 6 5
SPEAKER -
SPEAKER +
$\overline{\text{PTT}}$
SW B-
MIC HIGH AUDIO

LEGEND
Theory Note
Maintenance Note
Logic Ground
Chassis Ground
$ = Hex Number

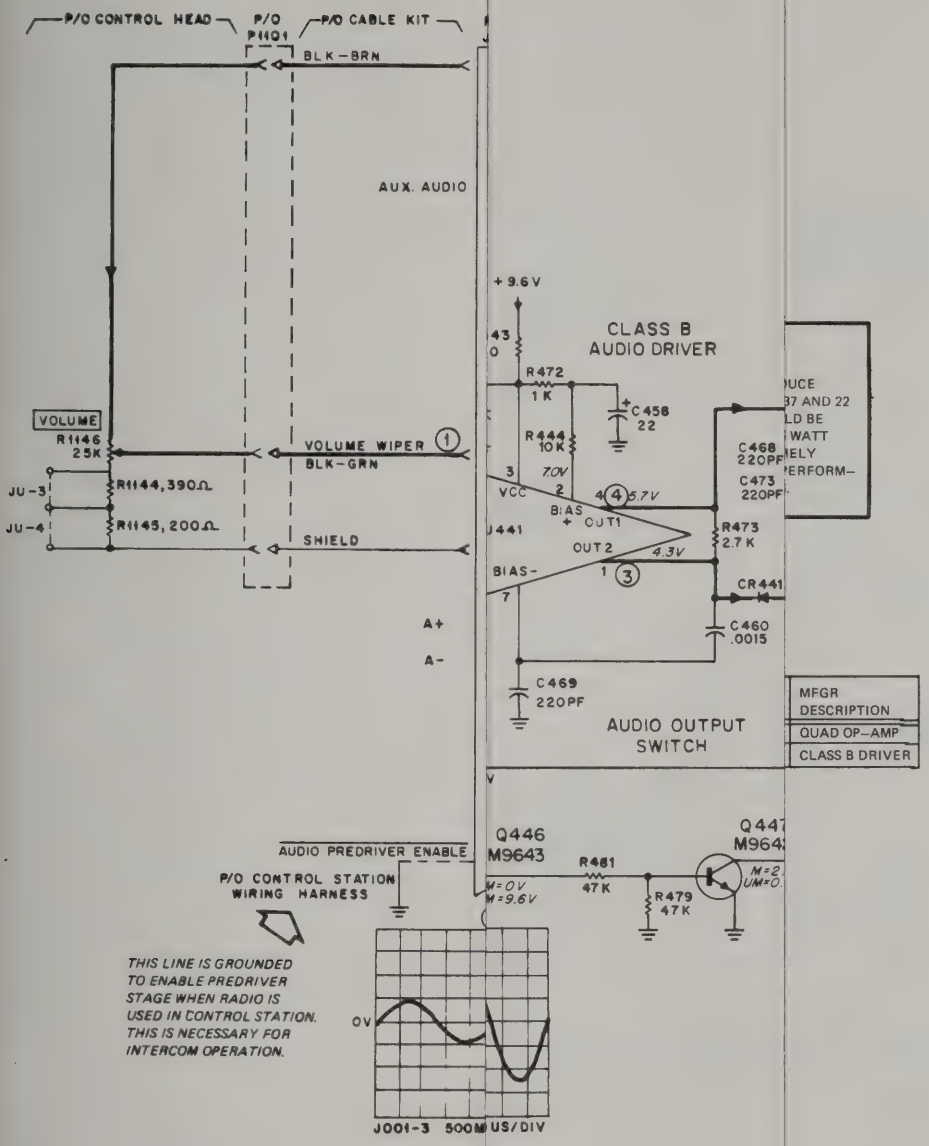
EEPS - 29666 - B

P602
(TO R.F. BOARD)

11 ADAPT

C GA
SGR
CR1,CR9

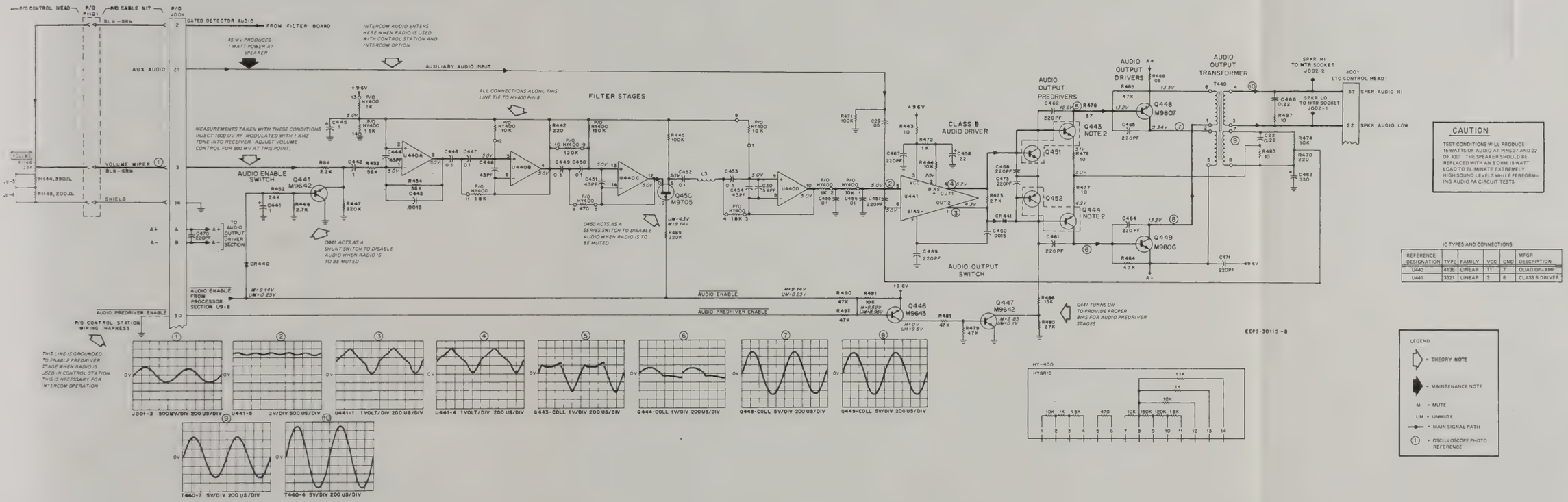
AGC
Q8 M9673
PROGRAMMABLE
UNI-JUNCTION



NOTES:

1. UNLESS OTHERWISE STATED, ALL RESISTOR VALUES ARE IN OHMS; ALL CAPACITOR VALUES ARE IN MICROFARADS; ALL INDUCTOR VALUES ARE IN MICROHENRIES.
2. THE AUDIO OUTPUT PREDRIVERS Q443/Q451 (01–80726D63) AND Q444/Q452(01-80726D64)ARE MATCHED PAIRS. Q451 AND Q452 ARE USED AS TEMPERATURE COMPENSATION DIODES AND ARE ATTACHED TO THEIR ASSOCIATED TRANSISTORS BY A METAL BAND TO INSURE GOOD THERMAL CONTACT. THESE STAGES MUST BE REPLACED INTACT (THE TRANSISTOR AND ITS ASSOCIATED DIODE) TO INSURE PROPER OPERATION.
3. THE PROCESSOR SECTION AND THE RECEIVE AUDIO OUTPUT SECTION OF THE PERSONALITY BOARD ARE SHOWN ON SEPARATE DIAGRAMS. ALL FUNCTIONAL SIGNALS TO THE PERSONALITY BOARD ARE SHOWN ON THE APPROPRIATE DIAGRAM. THE SW B+, SW B–, +9.6 V, AND +5 V SUPPLY INPUT CONNECTIONS ARE SHOWN ON THE PROCESSOR SECTION DIAGRAM. THE A+ AND A– INPUT CONNECTIONS (USED ONLY AT THE AUDIO OUTPUT STAGE) ARE SHOWN ON THE RECEIVE AUDIO OUTPUT DIAGRAM.

Trunked Personality Board, Audio Section
Schematic Diagram
Motorola No. ***EEPS-30115-B***
1/15/81-PHI



CAUTION

TEST CONDITIONS WILL PRODUCE 15 WATTS OF AUDIO AT PINS 37 AND 22 OF J001. THE SPEAKER SHOULD BE REPLACED WITH AN 8 OHM 15 WATT LOAD TO ELIMINATE EXTREMELY HIGH SOUND LEVELS WHILE PERFORMING AUDIO PA CIRCUIT TESTS.

IC TYPES AND CONNECTIONS

REFERENCE DESIGNATION	TYPE	FAMILY	VCC	GND	MFGR DESCRIPTION
U440	4136	LINEAR	11	7	QUAD OP-AMP
U441	3321	LINEAR	3	8	CLASS B DRIVER

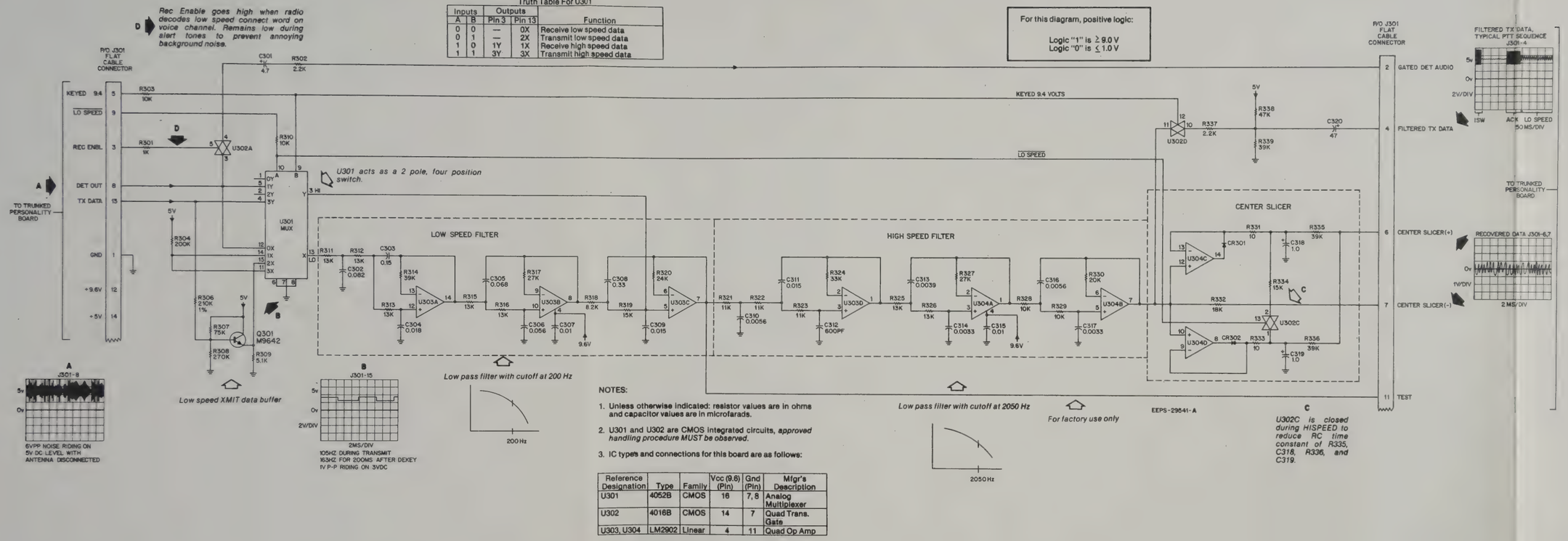
LEGEND

- = THEORY NOTE
- = MAINTENANCE NOTE
- M = MUTE
- UM = UNMUTE
- = MAIN SIGNAL PATH
- (1) = OSCILLOSCOPE PHOTO REFERENCE

NOTES:

1. UNLESS OTHERWISE STATED, ALL RESISTOR VALUES ARE IN OHMS, ALL CAPACITOR VALUES ARE IN MICROFARADS ALL INDUCTOR VALUES ARE IN MICROHENRIES
2. THE AUDIO OUTPUT PREDRIVERS Q443/Q451 (01-80726D63) AND Q444/Q452 (01-80726D64) ARE MATCHED PAIRS. Q451 AND Q452 ARE USED AS TEMPERATURE COMPENSATION DIODES AND ARE ATTACHED TO THEIR ASSOCIATED TRANSISTORS BY A METAL BAND TO INSURE GOOD THERMAL CONTACT. THESE STAGES MUST BE REPLACED INTACT (THE TRANSISTOR AND ITS ASSOCIATED DIODE) TO INSURE PROPER OPERATION
3. THE PROCESSOR SECTION AND THE RECEIVE AUDIO OUTPUT SECTION OF THE PERSONALITY BOARD ARE SHOWN ON SEPARATE DIAGRAMS. ALL FUNCTIONAL SIGNALS TO THE PERSONALITY BOARD ARE SHOWN ON THE APPROPRIATE DIAGRAM. THE SW B+ SW B- +9.6 V AND +5 V SUPPLY INPUT CONNECTIONS ARE SHOWN ON THE PROCESSOR SECTION DIAGRAM. THE A+ AND A- INPUT CONNECTIONS (USED ONLY AT THE AUDIO OUTPUT STAGE) ARE SHOWN ON THE RECEIVE AUDIO OUTPUT DIAGRAM.

Trunked Personality Board, Audio Section
Schematic Diagram
*Motorola No. **EEPS-30115-B***
1/15/81-PHI



1. Unless otherwise indicated: resistor values are in ohms and capacitor values are in microfarads.
2. U301 and U302 are CMOS integrated circuits, *approved handling procedure MUST be observed.*
3. IC types and connections for this board are as follows:

Reference Designation	Type	Family	Vcc (9.6) (Pin)	Gnd (Pin)	Mfgr's Description
U301	4052B	CMOS	16	7, 8	Analog Multiplexer
U302	4016B	CMOS	14	7	Quad Trans. Gate
U303, U304	LM2902	Linear	4	11	Quad Op Amp

Trunked Filter Board Schematic Diagram
Motorola No. EEPS-29541-A
10/30/80-PHI

parts list

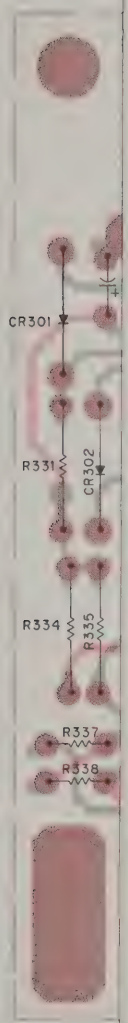
TRN4274A Filter Board — PL-7023-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 5%; 50 V: unless otherwise stated
C301	23-11013D55	4.7 ± 20%; 20 V
C302	8-11017B18	.082 ± 10%
C303	8-82905G34	.15
C304	8-11017B10	.018 ± 10%
C305	8-11017A16	.068
C306	8-11017A15	.056
C307	21-11015A07	.01 + 80-20%; 100 V
C308	8-82905G42	.33 ± 10%
C309	8-11017A09	.015
C310	8-11017A19	.0056
C311	8-11017A09	.015
C312	21-82633E23	600 pF; 100 V
C313	8-11017A18	.0039
C314	8-11017A05	.0033
C315	21-11015A07	.01 + 80-20%; 100 V
C316	8-11017A19	.0056
C317	8-11017A05	.0033
C318, 319	23-11013F57	1 ± 20%; 35 V
C320	23-84538G29	47 ± 20%; 10 V
		diode: (see note)
CR301, 302	48-84616A01	hot carrier
		transistor: (see note)
Q301	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R301	6-11009A49	1k
R302	6-11009E57	2.2k
R303	6-11009E73	10k
R304	6-11009E05	200k
R305		not used
R306	6-84640C76	210k ± .5%; 1/8 W
R307	6-11009A94	75k
R308	6-11009B08	270k
R309	6-11009E66	5.1k
R310	6-11009E73	10k
R311	6-11009E76	13k
R312	6-11009A76	13k
R313	6-11009E76	13k
R314	6-11009E87	39k
R315	6-11009A76	13k
R316	6-11009E76	13k
R317	6-11009E83	27k
R318	6-11009E71	8.2k
R319	6-11009A77	15k
R320	6-11009E82	24k
R321, 322	6-11009E74	11k
R323	6-11009E74	11k
R324	6-11009A85	33k
R325, 326	6-11009A76	13k
R327	6-11009A83	27k
R328	6-11009A73	10k
R329	6-11009E73	10k
R330	6-11009E80	20k
R331	6-11009A01	10
R332	6-11009E79	18k
R333	6-11009A01	10
R334	6-11009A77	15k
R335, 336	6-11009A87	39k
R337	6-11009E57	2.2k
R338	6-11009E89	47k
R339	6-11009E87	39k
		integrated circuit: (see note)
U301	51-82884L54	analog multiplexer
U302	51-82884L14	quad trans. gate
U303, 304	51-83629M09	quad op amp

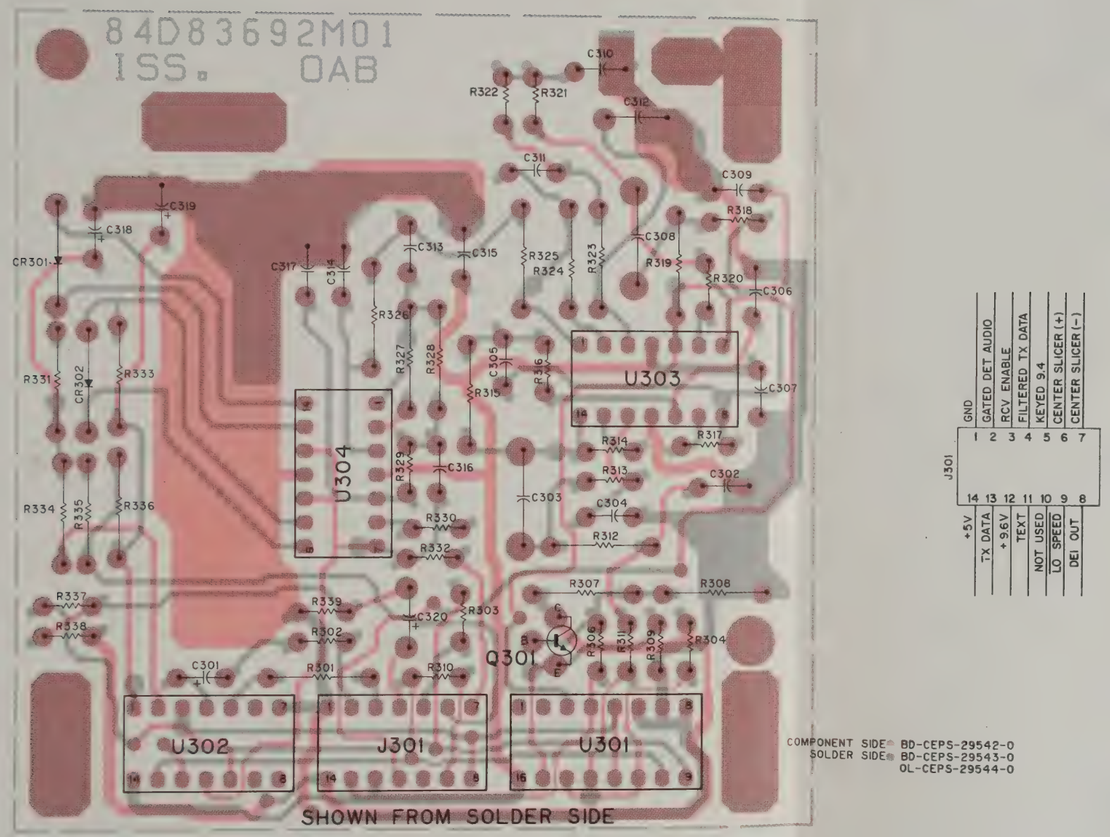
non-referenced items

30-83776M01	FLAT CABLE & CONNECTOR ASSEMBLY
42-83503M01	RETAINER; 4 used
3-10943D29	SCREW, tapping; 3.5 x 0.6 x 8mm; 4 used
84-83692M01	PC BOARD, filter

note: For optimum performance, replacement diodes, transistors and integrated circuits must be ordered by Motorola part numbers.



Trunked Filter Board Circuit Board Detail and Parts List
Motorola No. PEPS-29545-A
10/30/80-PHI



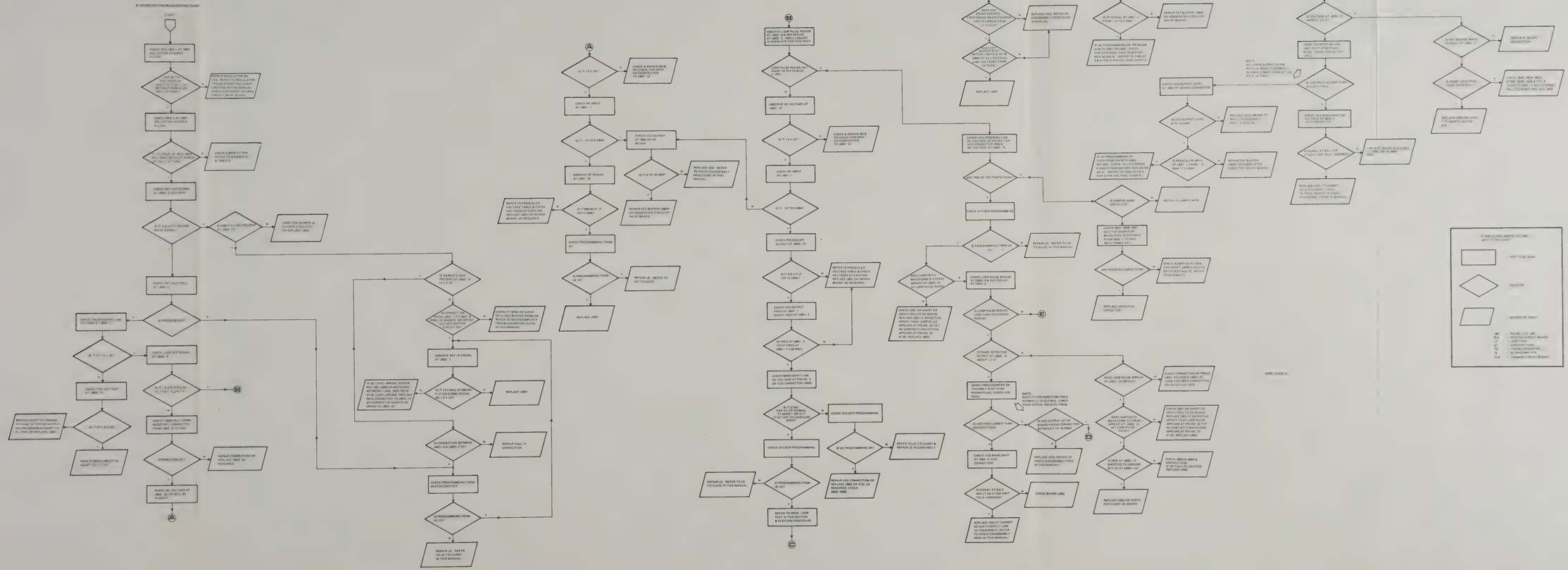
parts list

TRN4274A Filter Board — PL-7023-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 5%; 50 V: unless otherwise stated
C301	23-11013D55	4.7 ± 20%; 20 V
C302	8-11017B18	.082 ± 10%
C303	8-82905G34	.15
C304	8-11017B10	.018 ± 10%
C305	8-11017A16	.068
C306	8-11017A15	.056
C307	21-11015A07	.01 + 80-20%; 100 V
C308	8-82905G42	.33 ± 10%
C309	8-11017A09	.015
C310	8-11017A19	.0056
C311	8-11017A09	.015
C312	21-82633E23	600 pF; 100 V
C313	8-11017A18	.0039
C314	8-11017A05	.0033
C315	21-11015A07	.01 + 80-20%; 100 V
C316	8-11017A19	.0056
C317	8-11017A05	.0033
C318, 319	23-11013F57	1 ± 20%; 35 V
C320	23-84538G29	47 ± 20%; 10 V
		diode: (see note)
CR301, 302	48-84616A01	hot carrier
		transistor: (see note)
Q301	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R301	6-11009A49	1k
R302	6-11009E57	2.2k
R303	6-11009E73	10k
R304	6-11009E05	200k
R305		not used
R306	6-84640C76	210k ± .5%; 1/8 W
R307	6-11009A94	75k
R308	6-11009B08	270k
R309	6-11009E66	5.1k
R310	6-11009E73	10k
R311	6-11009E76	13k
R312	6-11009A76	13k
R313	6-11009E76	13k
R314	6-11009E87	39k
R315	6-11009A76	13k
R316	6-11009E76	13k
R317	6-11009E83	27k
R318	6-11009E71	8.2k
R319	6-11009A77	15k
R320	6-11009E82	24k
R321, 322	6-11009E74	11k
R323	6-11009E74	11k
R324	6-11009A85	33k
R325, 326	6-11009A76	13k
R327	6-11009A83	27k
R328	6-11009A73	10k
R329	6-11009E73	10k
R330	6-11009E80	20k
R331	6-11009A01	10
R332	6-11009E79	18k
R333	6-11009A01	10
R334	6-11009A77	15k
R335, 336	6-11009A87	39k
R337	6-11009E57	2.2k
R338	6-11009E89	47k
R339	6-11009E87	39k
		integrated circuit: (see note)
U301	51-82884L54	analog multiplexer
U302	51-82884L14	quad trans. gate
U303, 304	51-83629M09	quad op amp
		non-referenced items
	30-83776M01	FLAT CABLE & CONNECTOR ASSEMBLY
	42-83503M01	RETAINER; 4 used
	3-10943D29	SCREW, tapping; 3.5 x 0.6 x 8mm; 4 used
	84-83692M01	PC BOARD, filter

note: For optimum performance, replacement diodes, transistors and integrated circuits must be ordered by Motorola part numbers.

Trunked Filter Board Circuit Board Detail and Parts List
Motorola No. ***PEPS-29545-A***
10/30/80-PHI



Frequency Synthesizer Troubleshooting Chart
Motorola No. EEPS-31423-O
1/15/81-PHI

FREQUENCY SYNTHESIZER

1. GENERAL

The Trunked SYNTOR X frequency synthesizer is used to directly generate the first receive injection frequency and transmitter carrier. In the receive mode, the sythesizer locks on a frequency that is 53.9 MHz (first i-f) lower than the desired receive frequency. In the transmit mode, the synthesizer locks on the transmit output frequency. The synthesizer employs a phase-locked loop (PLL) that operates at half the desired output frequency and consists of: a 14.4 MHz reference oscillator, a low-noise voltage controlled oscillator (VCO), a high-speed programmable divide-by-3-or-4 variable modulus prescaler, a lower-speed programmable divider, a sample-and-hold phase detector, and a loop adaptive filter. It also uses a buffer doubler/splitter that doubles the VCO output frequency for use by the radio. The 14.4 MHz reference oscillator output is applied, via an injection tripler, to the second mixer of the receiver, where it serves as the low-side second injection frequency. The synthesizer circuits are located on the common circuits board, rf board, and in the internal casting.

2. THEORY OF OPERATION

2.1 INTRODUCTION

2.1.1 The PLL (phase-locked-loop) synthesizer is a single negative-feedback-loop that uses the phase of the input signals to the phase detector as the controlling variable. The output of a high-accuracy, temperature-compensated crystal reference oscillator (U608) is divided down in frequency by the reference divider (part of U602). The reference divider provides a high-stability 6.25 kHz square-wave output that is routed from the reference divider to the phase detector (U603-2) to serve as the reference frequency input.

2.1.2 The PLL negative feedback input, which originates at the VCO, is applied to the loop frequency input of the phase detector (U603-23). The VCO is an FET rf oscillator (Q652) which operates at approximately 405 MHz and which provides an output frequency proportional to the voltage on its steering line (P603-2). The VCO output frequency is divided down by a programmable N divider which provides a loop frequency output equal to the VCO output frequency divided by N, i.e.,

$$f_{(loop)} = f_{(vco)}/N$$

where $f_{(loop)}$ = N divider loop frequency output

$f_{(vco)}$ = VCO output frequency

N = integer

The loop frequency and the reference frequency are applied to the phase detector (U603-23, U603-2, respectively), whose function is to provide a dc output voltage proportional to the phase difference between the two frequencies (i.e., the loop and reference frequencies). Phase is used as the controlling variable since small phase errors may exist in the locked loop but frequency errors cannot occur. The phase detector dc output voltage (PHASE DET OUT on U603-15) is applied, via the loop adaptive filter, to the VCO steering line, thus completing the feedback loop. The loop filter controls the PLL closed loop response and removes noise from the phase detector output. The loop negative feedback action can be explained as follows. If the VCO output frequency goes high, the N divider loop frequency output also goes high, thus causing a leading phase displacement on the phase detector loop input. Since the reference signal phase does not change, the phase detector internal circuits detect this condition and cause the generation of a lower dc voltage at the output (U603-15). This signal is applied to the VCO steering line, via the loop adaptive filter, causing a reduction in frequency, thus compensating for the original frequency difference.

2.2 LOOP PROGRAMMING AND CONTROL

2.2.1 For frequency generation and control, the microcomputer reads the programming information from the code plug, combines it with the syn-

TRANSMIT MODE SELECT = $\overline{\text{ADAPT}} \bullet \overline{\text{RSW}}$

2.5.2.3 The output lines of the selector gates (U604A-D) are connected to transmission gates U605A-D, U606A-D, and U607B-C (gates U607A and U607D are not used). When a selector output is forced into a high level, the associated transmission gates turn on, passing the signals as a closed switch. Transmission gates U605A-D and U606A-D have ON impedances of less than 200 ohms, and gates U607A-D have ON impedances of less than 500 ohms.

2.5.3 Transmit Mode

2.5.3.1 When the synthesizer is in the normal transmit mode, the phase detector drives the TSW and $\overline{\text{ADAPT}}$ lines high and their complements, RSW and ADAPT, low. The output of gate U604A goes high, causing transmission gates U606A and U606B to turn on. The natural loop frequency of the synthesizer in this mode is approximately 15 Hz. The adaptive filter stays in this mode as long as the radio is transmitting.

2.5.3.2 In this mode, the steering line is filtered by resistor R633 and a shunt path to ground consisting of C638, C639, C672, and R634. (The ON impedance of the transmission gates is neglected.) Another shunt path to ground, consisting of R635, R636, C640, and C641, is connected to the phase detector output line but has minimal effect because of the high resistance of R635 (33 kilohms). The signal passes to the VCO via a test jumper (JU600) and J608-2.

2.5.4 Receive Mode

2.5.4.1 When the synthesizer is in the receive mode, the phase detector drives the RSW and $\overline{\text{ADAPT}}$ lines high and their complements, TSW and ADAPT, low. The output of gate U604D goes high, causing transmission gate U607B to turn on. The natural loop frequency of the synthesizer in this mode is approximately 75 Hz. The adaptive filter remains in this mode while the radio is in the receive mode.

2.5.4.2 In this mode, the steering line is filtered by R635, a shunt path consisting of R636, C640, and C641, and by R631 and C672. (The ON impedance of the transmission gates is neglected.) The signal passes through the test jumper to the VCO via J608-2.

2.5.5 Transmit-Adapt Mode

2.5.5.1 When the synthesizer is in the transmit-adapt mode, the TSW and ADAPT lines are driven high by the phase detector and their respective complements, RSW and ADAPT, are driven low. The output of U604B goes high, turning on transmission gates U605A, U605B, and U605D. Transmission gate U607A is also directly turned on by the ADAPT line. The synthesizer has a high natural loop frequency in this mode, allowing it to change frequencies rapidly. The adaptive filter is switched into this mode for approximately 12 milliseconds while the radio changes from the receive mode to the transmit mode. The transmitter is inhibited in this mode by the SYNTHESIZER ADAPT line.

2.5.5.2 In this mode, transmission gate U607A bypasses the greater part of the adaptive filter. A grounded capacitor, C639, is connected to the steering line (the ON impedance of the transmission gates is neglected). While the filter is in this mode, C639 and C672 are being charged. The charge on C672 prevents the VCO from changing frequency during the transition from the transmit-adapt mode to the transmit mode. C672 always remains connected to the steering line. The steering line passes to the VCO through the test jumper via J608-2.

2.5.6 Receive-Adapt Mode

2.5.6.1 When the synthesizer is in the receive-adapt mode, the RSW and ADAPT lines are driven high by the phase detector and their respective complements, TSW and ADAPT, are driven low. The output of gate U604C goes high, turning on transmission gates U605C, U606C, and U606D. Transmission gate U607A is also directly turned on by the ADAPT line. The synthesizer has a high natural loop frequency in this mode, allowing it to change injection frequencies rapidly. The adaptive filter switches into this mode for approximately 2.4 milliseconds while the radio changes from the transmit mode to the receive mode or from one receive frequency to another.

2.5.6.2 In this mode, the greater part of the adaptive filter is shorted by transmission gate U607A, and the steering line is connected to C641. (The ON impedance of the transmission gates is neglected.) When the filter is in the receive-adapt mode, C641 and C672 are being charged. The accumulated charge on C672 prevents the VCO from changing frequencies while the mode is changed from receive-adapt to receive. C672 always remains connected to the steering line. The steering line passes to the VCO through the test jumper and J608-2.

2.5.6.3 When the frequency is changed (or if, for any reason, the loop falls out-of-lock), the phase detector will cause the adaptive filter to switch to the ADAPT mode. Consequently, the $\overline{\text{ADAPT}}$ line switches to a low state, causing the OUT-OF-LOCK indicator light to turn on. Therefore, in normal operation of the frequency synthesizer, the OUT-OF-LOCK indicator turns on for a brief period whenever the frequency is being changed. A strongly lit indicator points to the presence of an out-of-lock fault in the frequency synthesizer. Thus it can be seen that this indicator is useful for troubleshooting purposes.

2.5.7 Super Filter

2.5.7.1 Because of the VCO requirements for a very pure dc supply voltage, an ultra-low-pass filter

(U607) is used to provide the VCO with very-low-noise +8.6 output voltage. Any ripple or noise present on the +9.6 V supply line is removed by the filter, thus preventing the unwanted modulation of the VCO. A 1-volt drop occurs across the filter, thus lowering the output voltage from +9.6 to +8.6 V.

2.5.7.2 The super filter consists of a low-pass filter, an error amplifier, and an external series-pass transistor (Q601). The +9.6 V supply is connected to U607-1 as well as to the emitter of Q601. Internally, the input from U607-1 passes through a low-pass filter to the non-inverting input of the error amplifier. C603, connected to U607-2, forms part of the low-pass filter. The output line (also connected to the collector of Q601) is fed back to the inverting input of the error amplifier through U607-4. The error amplifier output is connected to the base of Q601 via U607-3 and is used to control the conduction of this transistor. These connections enable the super filter to compare the output line voltage with the filtered input line voltage and to increase or decrease the conduction of Q601 to remove any ripple or noise present on the VCO supply line. The VCO supply is further filtered by C604, which is connected to ground. This filtered supply is then forwarded to the VCO through the VCO interconnect plate via J603-1. A +9.6V supply is also forwarded to the buffer doubler through the VCO interconnect plate via J603-6.

2.5.8 Feedback Buffer

2.5.8.1 A signal at the oscillator frequency is fed back from the buffer doubler/splitter to the main board. This signal is used by the divider/phase detector circuits to monitor the oscillator frequency.

2.5.8.2 The feedback buffer, Q602, accepts an input from a microstrip pickup located on the buffer doubler substrate. This input signal is forwarded via a coaxial cable and connector P/J600. The feedback amplifier output is coupled to the divide-by-3-or-4 prescaler (U601) via a matching network consisting of L601 and C607.

2.6 VOLTAGE-CONTROLLED OSCILLATOR (VCO)

2.6.1 General

2.6.1.1 Each Trunked SYNTOR X radio contains a voltage-controlled oscillator (VCO) which along with the buffer doubler amplifier provides the frequency-modulated transmit injection frequency and the first receive injection frequency.

2.6.1.2 After doubling, the VCO operating frequency range extends from 53.9 MHz below the lowest receiver operating frequency (797.1 MHz to 816.1 MHz) to the highest transmitter frequency (806 MHz to 825 MHz). The VCO and buffer doubler splitter also provide a feedback signal whose frequency is one-half of the injection frequency for use by the phase-locked-loop synthesizer. The VCO kit is constructed on an alumina thick-film microstrip substrate.

2.6.2 Oscillator Circuit

2.6.2.1 The oscillator employs a grounded-gate Colpitts oscillator that uses an FET (Q652) as the amplifying element. This oscillator operates at one-half the desired injection frequency: 398.55 to 412.5 MHz. The drain of Q652 is coupled to the main resonator transmission line through C660.

2.6.2.2 The transmission line is equipped with microstrip capacitors that act as trimming capacitors for the oscillator tank circuit. These capacitors, which are adjusted at the factory, are not dependent on the customer's frequencies.

2.6.2.3 The oscillator provides an output signal that is coupled to amplifier Q651, which is located on the VCO substrate. Q651, in turn, provides an output signal that is fed to the buffer doubler amplifier (Q675, Q676, Q678) which is located on an alumina substrate in a compartment adjacent to the VCO. The buffer doubler amplifier provides three output signals: (1) a signal at one-half the injection frequency that is coupled, via P600, to the rf board to drive the prescaler to provide feedback to the phase-locked-loop synthesizer; (2) a second signal that is coupled to the transmitter via P700; and, (3) a third signal that is fed to the receiver injection filter.

2.6.3 Steering Line Circuit

2.6.3.1 The STEERING line, in conjunction with the BAND SHIFT line (when used), determines the VCO operating frequency. The STEERING line is driven by the phase detector (U603) and is coupled to the VCO, via the adaptive filter. The phase detector provides a dc output voltage to maintain the VCO output at the desired frequency. When the oscillator frequency is changed, the phase detector dc output voltage shifts to change the oscillator frequency and then maintains this new frequency.

2.6.3.2 The STEERING line is coupled from the rf board via pin 2 of the VCO interconnect plate (J603); this plate contains the rf filters that shield the VCO. The STEERING line dc voltage level determines the capacitance of diodes CR652, CR653, CR654, and CR655 which, in turn, controls the oscillator frequency. An increase in the STEERING line voltage causes the capacitance of these diodes to decrease and the oscillator frequency to increase. On the other hand, a decrease in the STEERING line voltage causes an increase in the capacitance of the diodes and a reduction in the oscillator frequency.

Table 2. Problems and Their Possible Causes in a Trunked SYNTOR X Synthesizer

Problems	Possible Source of Trouble
Synthesizer does not lock	refer to synthesizer troubleshooting chart.
Synthesizer locks on wrong frequency	reference oscillator (U608) frequency off (should be 14.4 MHz ± 2 ppm).
NOTE A frequency error of 12.5 kHz, 25.0 kHz, or 37.5 kHz can be caused by a defective prescaler or by shorted or open programming lines from the divider to the prescaler (U601-7, U601-6).	erroneous divider programming from microcomputer (possible defective memory module or microcomputer).
	defective divider 1C (U602).
	defective prescaler IC (U601).
Excessive reference frequency feedthrough (spurs)	defective hold capacitors (C632, C633((open or leaky).
	defective ramp capacitor (C630.
	defective phase detector (U603).
	adaptive filter in ADAPTIVE mode or shorted input to output; guard band shorted to VCO steering line or other adaptive filter mode.
Noisy frequency lock	marginal input level to prescaler (U601-1), loop divider (U602-25) or reference dividur (U602-2).
	loose connection, cold solder joint, or faulty component.
	noisy Q603.
	defective phase detector (U603).
	defective divider (U602) or prescaler (U601) (jittery).
	noisy 5 V or 9.6 V supplies.
	defective adaptive filter (open capacitors).
Slow switching response	improper synchronization from microcomputer. Check divider programming.
	malfunctioning adaptive filter, check U604, U605, U606, U607.
	phase detector (U603) gain too low (overdamped response) or too high (underdamped response); check R625, R626, RT600, C630, Q603.
	leaky adaptive filter capacitors or transmission gates (U605, U606, U607, C639, C641).
	leaky VCO varactor diodes.

Table 3. Phase Detector (U603) Pin Connections and Voltages

Pin No.	Function	To/From	Nominal Voltage
1	high current ground	—	0 V dc
2	REFERENCE IN	from U602-5	0 V to 4.3 V square wave (160 us period)
3	LOW BANDWIDTH	from U602-17	0 V dc receive; 5 V dc transmit
4	SYNTHESIZER SYNC	to microcomputer	60 us positive pulse 0-5 V at loop pulse rate; equal to pin 2 if pin 11 is low.
5	FREQUENCY CHANGE	from U602-18	0.5 V 11.1 us when frequency changes
6	no connection		
7	ADAPT	to adaptive filter	9.6 to 0.6 V single pulse, 2.4 ms (Rx) dekey; 12 ms (Tx) key.
8	TSW	to adaptive filter	0 V dc receive, 9.6 V dc transmit
9	RSW	to adaptive filter	9.6 V dc receive, 0 V dc transmit
10	ADAPT	to adaptive filter	0-9.0 V single pulse, 2.4 ms (Rx) dekey; 12 ms (Tx) key.
11	LOCK		0 V dc when out of lock; 8 V dc when in lock.
12	HOLD 1	CS11	1.4 to 8 V dc (use high input impedance voltmeter)
13	HOLD 2	CS12	1.4 to 8 V dc (use high input impedance voltmeter)
14	A+		9.6 V dc
15	PHASE DET OUTPUT	to adaptive filter	1.2 to 9.5 V dc (depending on loop output frequency)
16	low current ground		0 V dc
17	EXT PNP BASE	to pnp Q604 base	8.9 V dc
18	VCC	from regulator	9.6 V dc
19	RAMP BASE	to pnp Q603 base (ramp generator	9.1 V dc
20	FILTERED 9.1 V	to R624, R625, RT600, C629	9.1 V dc
21	RAMP RES	to R626, pnp Q603 emitter	8.0 to 8.7 V dc rectangular wave @reference rate.
22	SAMPLE TIMING CAP.	to C631	0 to 2 V sawtooth wave at loop pulse rate.
23	LOOP IN PULSE	from U602-9 via C628	1.4 V pulse riding on 1.6 V dc (160 us, typical period)
24	RAMP CAP	from C630 and ramp pnp Q603 collector	flat top ramp waveform at reference rate, top voltage 1.4 to 7 V (depending on loop output frequency)

Table 4. Divider (U602) Pin Connections and Voltages

Pin No.	Function	To/From	Nominal Voltages
1*	GND		0 V dc
2	REF IN	from U608 (reference oscillator)	1.5 V dc + 0.6 V pp ac (14.4 MHz)
3*	3.6 MHz OUT	to microcomputer	1 V pp (3.6 MHz)
4	GND		0 V dc
5*	REFERENCE OUT	to U603-2 (phase detector	0 to 4.3 V square wave (5.0 to 6.25 kHz)
6	NC		
7	NC		
8	NC		
9*	LOOP OUT	to phase detector & prescaler	2.9 V to 4.3 V narrow pulse (1.4 V pp) (160 us nominal period)
10*	VCC	from regulator	5 V dc
11	DØ	from microcomputer	0 to 5 V pulse train
12	D1	from microcomputer	0 to 5 V pulse train
13	D2	from microcomputer	0 to 5 V pulse train
14	D3	from microcomputer	0 to 5 V pulse train
15	C0	to prescaler	0 to 5 V dc
16	C1	to prescaler	0 to 5 V dc
17	LOW BANDWIDTH	to phase detector	0 to 5 V dc
18	FREQ CHANGE	to phase detector	0 to 5 V dc
19	VC01	NC	—
20	VC02	to band shift driver	0 to 0.7 V dc
21	NC	—	—
22	VBB	to divider	1.5 V dc
23	AØ	from microcomputer	0 to 5 V pulse train
24	A1	from microcomputer	0 to 5 V pulse train
25	PRESCALE IN	from prescaler	1.5 V dc + 0.7 V pp ac (approx. 150 MHz)
26	A2	from microcomputer	0 to 5 V pulse train
27*	STROBE	from microcomputer	0 to 5 V pulse train (7 pulses/train)

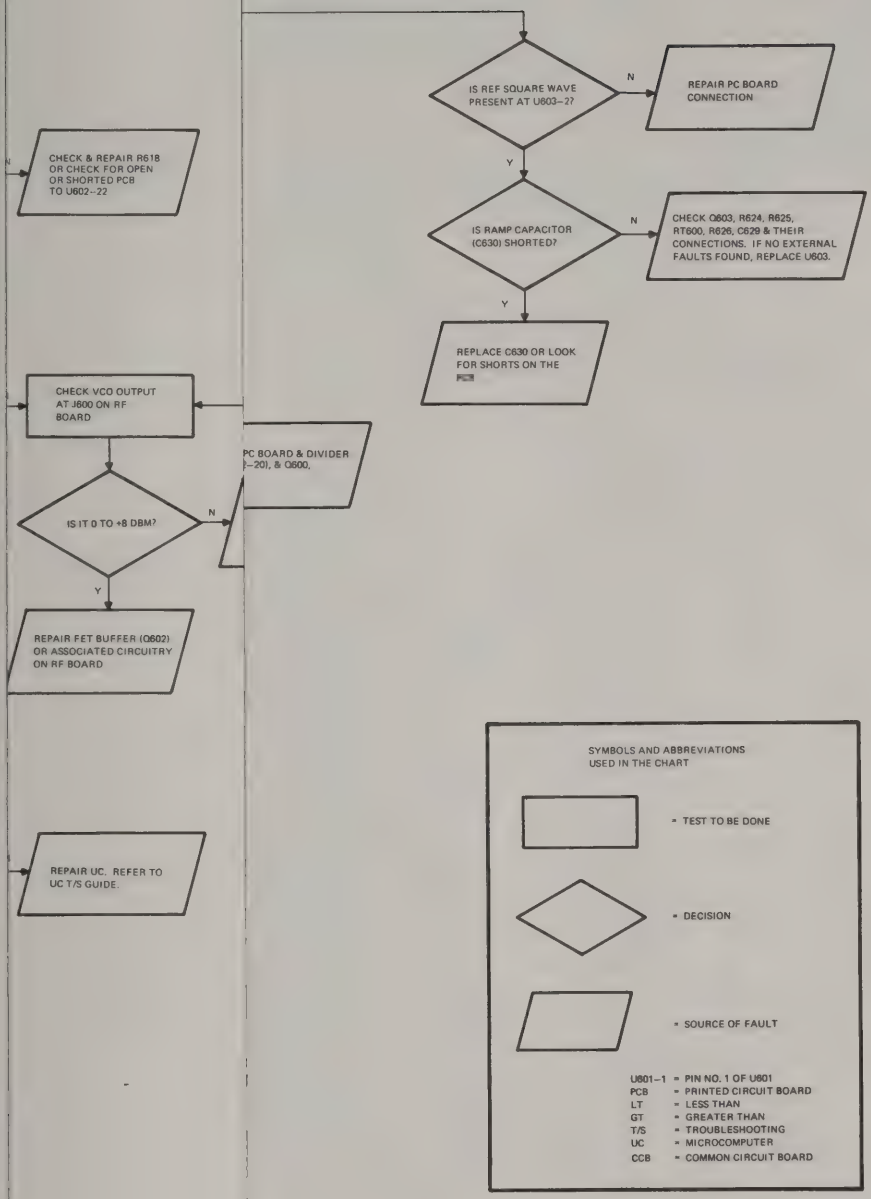
*SHOULD BE CHECKED FIRST

Table 5. Prescaler (U601) Pin Connections and Voltages

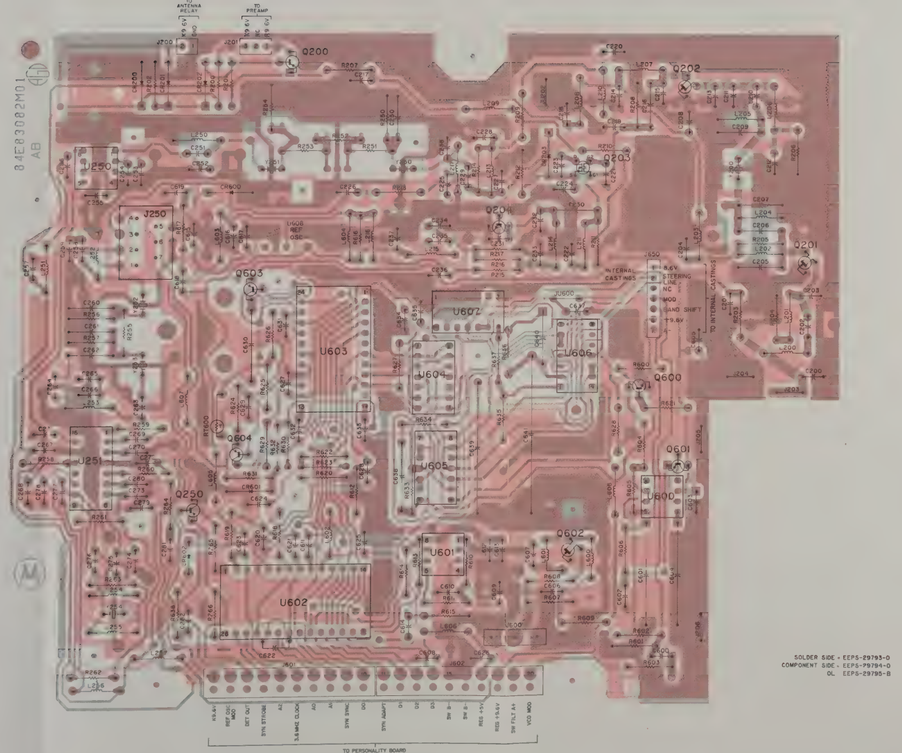
Pin No.	Function	To/From	Nominal Voltage
1	FIN	from VCO buffer	-12 to 0 dBm (at half carrier or half first injection freq.) riding on 3.8 V dc
2	VBB		3.8 V dc, bypassed for rf
3	PRES CALE OUT	to divider (U602)	0 dBm (0.6 V pp) riding on dc level of 3.6 V dc at approx. one-third VCO freq. (± 50 ppm).
4	GND		0 V dc
5	FV	from divider (U602)	1.4 V p narrow pulse at reference freq. (6.25 kHz) riding on 3.4 V dc
6	$\overline{C1}$	from divider	dc level (programming bit) 0 or 5 V dc; test memory module mode (4) 0 V dc; mode (5) 5 V dc
7	$\overline{C0}$	from divider	dc level (programming bit) 0 or 5 V dc; test memory module mode (4) 5 V dc; mode (5) 0 V dc
8	VCC	from regulator	+ 5.0 V ± 0.1 V

Table 6. Super Filter Pin Connections and Voltages

Pin No.	Function	To/From	Nominal Voltage
1	VCC	from 9.6 V regulator	9.6 V dc
2	FILTER CAP.	C603	7.1 V dc
3	EXT. DRIVER CONTROL	Q601 base	8.9 V dc
4	8.6 V OUT	to VCO	8.6 V dc
5	Ground (internal NPN emitter)	from regulator	0 V dc
6	Internal NPN collector	to modulation compensation potentiometer R602	—
7	Internal NPN base	from VCO bandshift, R604, R605	0.2 V, talk-around transmit; 0.7 V, standard transmit, receive
8	NC		



Frequency Synthesizer
Troubleshooting Chart
Motorola No. EEPS-31423-O
1/15/81-PHI



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Frequency Synthesizer
RF Board Circuit Board Detail and Parts List for Synthesizer VCO and VCO Buffer/Doubler Motorola No. PEPS-30806-B (Sheet 1 of 2)
1/15/81-PHI

parts list

p/o TRN8860A Synthesizer Section of RF Board — PL-6997-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ± 10%; 100 V: unless otherwise stated
C600	23-11013C54	10 ±20%; 15 V
C601	23-82783B31	47 ±20%; 20 V
C602	21-11015A07	.01 +80-20%
C603	23-11013C54	10 ±20%; 15 V
C604	23-82783B31	47 ±20%; 20 V
C605 thru 608	21-11014H32	20 pF ± 5%
C609	8-11017B17	.01; 50 V
C610	21-11014H32	20 pF ± 5%
C611	8-11017B17	0.1; 50 V
C612	21-11014H32	20 pF ± 5%
C613, 614	21-11015B05	220 pF
C615, 616	21-11015A07	.01 +80-20%
C617, 618	21-11014H32	20 pF ± 5%
C619	21-11015A07	.01 +80-20%
C620	8-11017B17	0.1; 50 V
C621, 622	21-11015B05	220 pF
C623	21-11014H29	15 pF ± 5%
C624	21-11015B05	220 pF
C625	8-11017B17	0.1; 50 V
C626	23-11013F10	0.56; 35 V
C627	23-11013D55	4.7; 20 V
C628	21-11015B01	100 pF
C629	23-84536G06	47; 20 V
C630	8-80027B08	.0039 ± 5%
C631	8-11017B07	.0068; 50 V
C632	8-11017B06	.0047; 50 V
C633	8-11017B01	.001; 50 V
C634	21-11015A07	.01 +80-20%
C635, 637	21-11014H32	20 pF ± 5%
C638	23-82783B26	1.0; 35 V
C639	8-80026B02	5.0, 50 V
C640	23-84762H30	0.27; 35 V
C641	8-83862M01	1.0
		diode: (see note 1.)
CR600	48-82139G01	germanium
CR601	48-83329G02	silicon, 4 diode stack
CR602	48-84404E01	light emitting, red
		connector, receptacle:
J600	9-84231B02	phono, female (board mounting)
J601, 602	9-83445L09	female, 10-contact
J603	9-83730M01	female, 7-contact
JU600	10-518	wire, jumper no. 22 solid
		coil, rf:
L600	24-83961B01	3-turns; coded BRN
L601	24-83884G06	4-1/2 turns, coded WHT
L602	24-83961B01	3-turns; coded BRN
L603, 604	24-82723H07	10 uH
L605	24-83397L07	10 uH
L606	24-83961B01	3-turns; coded BRN
L607, 608	24-82723H07	10 uH
		transistor: (see note 1.)
Q600	48-869642	NPN; type M9642
Q601	48-869681	PNP; type M9681
Q602	48-869839	N-channel FET; type M9839
Q603	48-869548	PNP; type M9548
Q604	48-869643	PNP; type M9643
		resistor, fixed: ± 5%; 1/4 W:
R600	6-11008A01	10
R601	6-11009A97	100k
R602	6-11009A93	68k
R603	6-11009A65	4.7k
R604, 605	6-11009A89	47k
R606	6-124B55	2.7
R607	6-11008A25	100
R608	6-11009A17	47
R609	6-11009A25	100
R610	6-11009A17	47
R611	6-11009A49	1k
R612	6-11009A73	10k
R613, 614	6-11009A67	5.6k
R615	6-11009A41	470
R616	6-11009A25	100
R617	6-11009A75	12k
R618	6-11009A49	1k
R619	6-11009A41	470
R620	6-11009A65	4.7k
R621	6-11009A73	10k
R622, 623	6-11009A67	5.6k
R624	6-11009A29	150
R625	6-11009A39	390
R626	6-11009A33	220
R627	6-11009A51	1.2k
R628	6-11009A49	1k
R629	6-11009A11	27
R630	6-11009A36	2k
R631	6-11009A69	6.8k
R632	6-11009A59	2.7k
R633	6-11008A06	220k
R634	6-11008A87	5.6k
R635	6-11009A65	33k
R636	6-11009A61	3.3k
R637	6-11009A57	2.2k
R638	6-11008A47	820
		thermistor:
RT600	6-858402	1k @ 25°C
		integrated circuit: (see note 1.)
U600	51-8478BF65	super filter; type M9865
U601	51-8478BF68	prescaler; type M9866
U602	51-8387TM18	divider; type M7718
U602 alternate	51-8478BF63	divider; type M9863
U603	51-8478BF59	phase detector; type M9859
U604	51-8288HL04	two-input quad NOR gate; type M8404
U605, 606	51-8288HL71	quad analog switch; type M8471
U607	51-8288HL72	quad analog switch; type M8472
U608	51-8029TB01	ref osc; type M9101

notes:
1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers
2. For parts not listed in the above parts list refer to the mechanical parts section.

TRN8870A VCO (Standard) — PL-7232-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ± 5%; 50 V: unless otherwise stated
C650	21-84873H59	100
C654	21-84873H70	100 (TRN8870A only)
	or 21-84736E21	100 (TRN4405A only)
C656	21-84873H59	100
C657	21-84736E26	2.7 ± 0.25
C658	21-84873H59	100
C659, 660	21-84736E30	10 ± 0.5
C661, 662, 663	21-84873H58	100
C664	21-84736E30	10 ± .25
C665	21-84736E23	1.5 ± .25
C666	21-84873H63	39
C667 thru 670	21-84873H59	100
C671	21-84736E18	5.6 ± .25
C672	8-80027B04	.039 ± 10%
C673	21-84736E24	1.8 ± .25
		diode: (see note 1.)
CR650	48-84622E02	pin
CR651 thru 655	48-82190H55	varactor
CR656	48-8416AA01	hot carrier
CR657	48-82190H55	varactor
		coil, rf:
L651, 652, 653	24-82723H05	410 nH
L655 thru 658	24-82723H05	410 nH
L659	1-80702B04	ferrite bead
L660	24-05318D01	7-1/2 turns
		connector, plug:
P603	9-83729M01	female, 7-contact
		transistor: (see note 1.)
Q651	48-84411L54	NPN; type M1154
Q652	48-84839C30	N-channel FET; type M3930
		resistor, fixed:
R650, 651, 652		non-replaceable parts (note 6)
R654 thru 661		non-replaceable parts (note 6)
R662	6-185A97	100k ± 5%; 1/8 W
		thermistor:
RT650	6-865641	300 @ 25°C
W652	30-83261G01	cable, coax, mini, 50 ohm

notes:
1. For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.
2. Replacement part for VCO feedthru plate should be ordered as Motorola Kit No. TRN8872A VCO Interconnect. This kit includes filters FL1 thru 7, and feedthru plate.

TRN8871A VCO Buffer/Doubler — PL-6996-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ± 5%; 50 V: unless otherwise stated
C676, 677	21-84873H59	100
C678	21-84547A13	0.1 uF ± 10%
C679	21-84873H44	39
C681	21-84873H36	12 ± 10%
C682	21-84873H01	3.3 ± .5
C683	21-84873H56	8.2 ± .5
C685	21-84873H37	15 ± 10%
C686	21-84873H44	39
C687	21-84873H60	2.7 ± .25
C688	21-84736E18	5.6 ± .25
C689	21-84873H16	22
		coil, rf:
L676	24-82723H28	290 nH
L677	24-05486C21	5 turns
L679	24-05318D05	7 turns
L680	24-82723H28	290 nH
L681	24-05318D09	2 turns
		connector, plug:
P101	28-8422B04	phono, male
		transistor: (see note 1.)
Q675	48-84411L54	NPN, type M1154
Q676	48-84411L53	NPN; type M1153
Q678	48-84411L37	NPN; type M1137
		resistor, fixed:
R675	6-185A71	8.2k ± 5%; 1/8 W
R676 thru 680	—	non-replaceable parts (note 7)

notes:
1. For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers
2. For parts not listed in the above parts list refer to the Mechanical parts section

)ROLA T NO.	DESCRIPTION
306	220k
A67	5.6k
A85	33k
A61	3.3k
A57	2.2k
A47	820
	thermistor:
2	1k @25°C
	integrated circuit: (see note 1.)
3F65	super filter; type M6865
3F68	prescaler; type M6868
7M18	divider; type M7718
3F63	divider; type M6863
3F59	phase detector; type M6859
4L04	two-input quad NOR gate; type M8404
4L71	quad analog switch; type M8471
4L72	quad analog switch; type M8472
1B01	ref osc; type M9101

ınce, diodes, transistors, and integrated circuits must be art numbers.
he above parts list refer to the mechanical parts section.

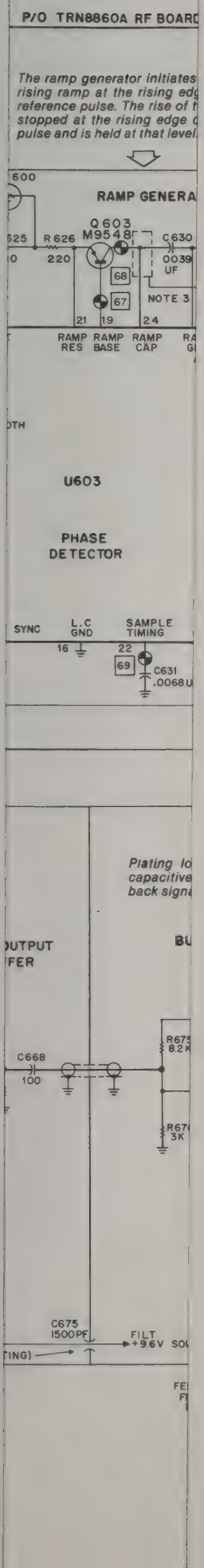
d) PL-7232-O

TOROLA RT NO.	DESCRIPTION
	capacitor, fixed: pF ± 5%; 50 V: unless otherwise stated
;73H59	100
173H70	100 (TRN8870A only)
34736E21	100 (TRN4405A only)
173H59	100
'36E26	2.7 ± 0.25
;73H59	100
'36E30	10 ± 0.5
173H59	100
'36E30	10 ± .25
'36E23	1.5 ± .25
;73H63	39
,73H59	100
'36E18	5.6 ± .25
'7B04	.039 ± 10%
'36E24	1.8 ± .25
	diode: (see note 1.)
;22E02	pin
90H55	varactor
;16A01	hot carrier
90H55	varactor
	coil, rf:
'23H05	410 nH
'23H05	410 nH
12B04	ferrite bead
118D01	7-1/2 turns
	connector, plug:
:9M01	female, 7-contact
	transistor: (see note 1.)
111L54	NPN; type M1154
139C30	N-channel FET; type M3930
	resistor, fixed:
	non-replaceable parts (note 6)
	non-replaceable parts (note 6)
\97	100k ± 5%; 1/8 W
	thermistor:
;41	300 @25°C
161G01	cable, coax, mini, 50 ohm

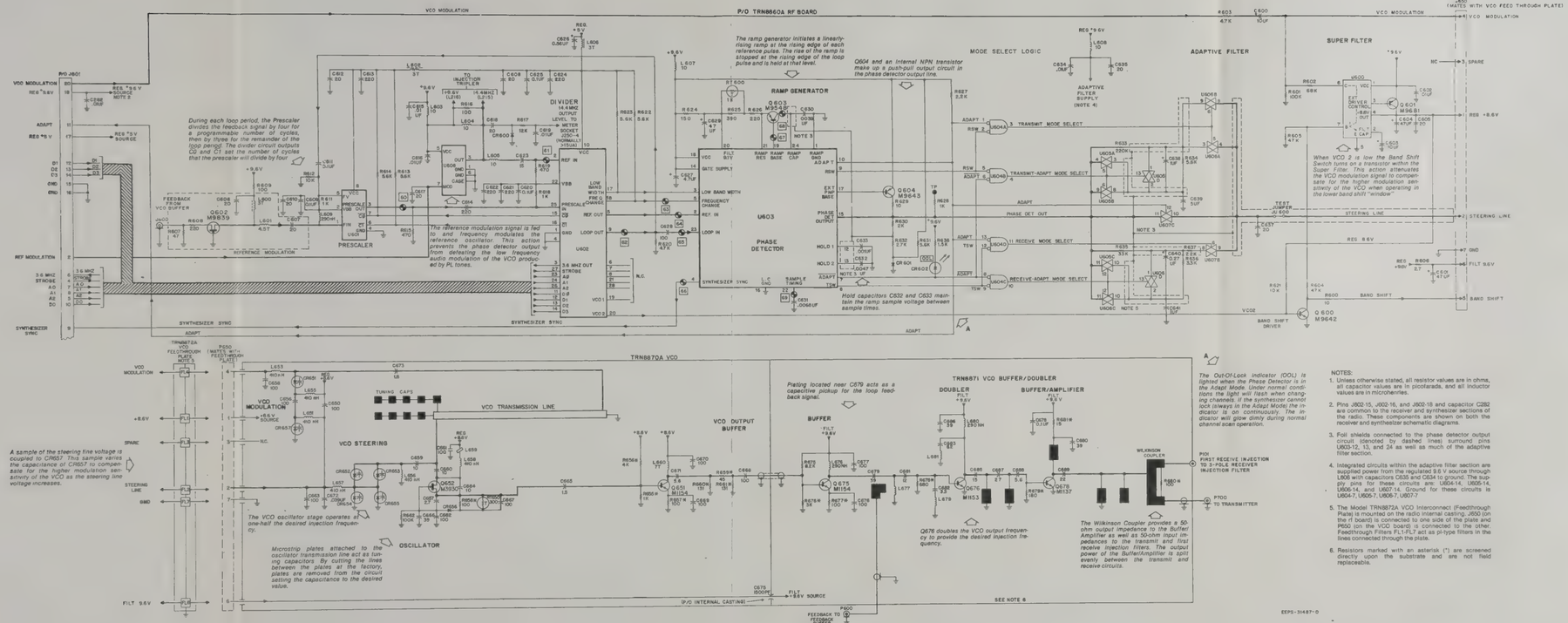
nance, diodes, transistors and integrated circuits must be part numbers.
- VCO feedthru plate should be ordered as Motorola Kit No. rconnect. This kit includes filters FL1 thru 7, and feedthru

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ± 5%; 50 V: unless otherwise stated
C676, 677	21-84873H59	100
C678	21-84547A13	0.1 uF ± 10%
C679	21-84873H44	39
C681	21-84873H36	12 ± 10%
C682	21-84873H01	3.3 ± .5
C683	21-84873H56	8.2 ± .5
C685	21-84873H37	15 ± 10%
C686	21-84873H44	39
C687	21-84873H60	2.7 ± .25
C688	21-84736E18	5.6 ± .25
C689	21-84873H16	22
		coil, rf:
L676	24-82723H28	290 nH
L677	24-05486C21	5 turns
L679	24-05318D05	7 turns
L680	24-82723H28	290 nH
L681	24-05318D09	2 turns
		connector, plug:
P101	28-8422B04	phono, male
		transistor: (see note 1.)
Q675	48-84411L54	NPN; type M1154
Q676	48-84411L53	NPN; type M1153
Q678	48-84411L37	NPN; type M1137
		resistor, fixed:
R675	6-185A71	8.2k ± 5%; 1/8 W
R676 thru 680	—	non-replaceable parts (note 7)

notes:
1. For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.
2. For parts not listed in the above parts list refer to the Mechanical parts section.



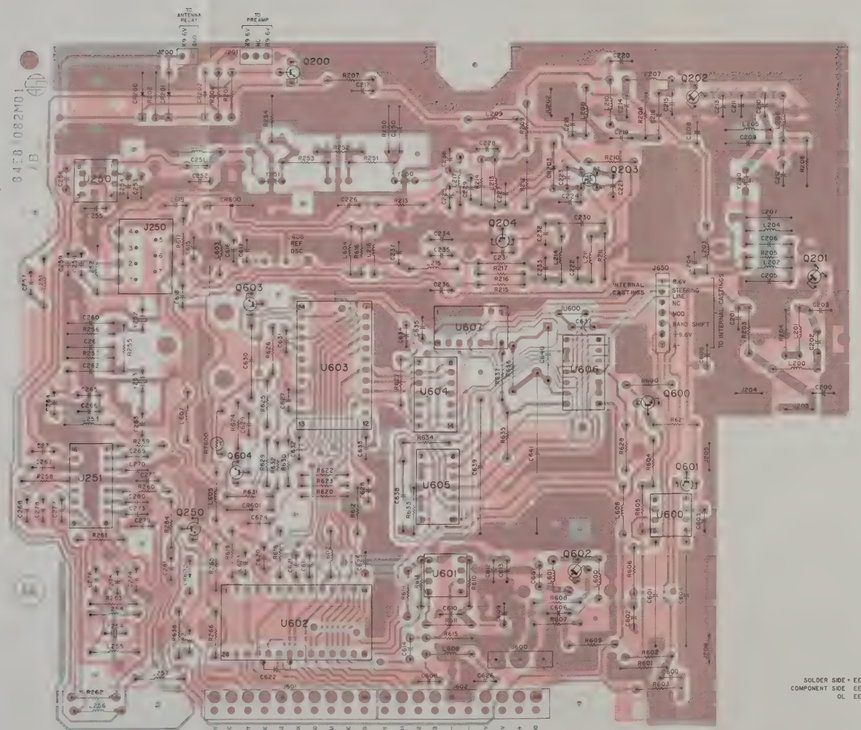
Frequency Synthesizer Schematic Diagram
Motorola No. ***PEPS-30806-B***
(Sheet 2 of 2)
1/15/81-PHI



NOTES:

1. Unless otherwise stated, all resistor values are in ohms, all capacitor values are in picofarads, and all inductor values are in microhenries.
2. Pins J802-15, J602-16, and J802-18 and capacitor C282 are common to the receiver and synthesizer sections of the radio. These components are shown on both the receiver and synthesizer schematic diagrams.
3. Foil shields connected to the phase detector output circuit (denoted by dashed lines) surround pins U803-12, 13, and 24 as well as much of the adaptive filter section.
4. Integrated circuits within the adaptive filter section are supplied power from the regulated 9.6 V source through L608 with capacitors C638 and C634 to ground. The supply pins for these circuits are: U604-14, U605-14, U606-14, and U607-14. Ground for these circuits is U604-7, U605-7, U606-7, U607-7.
5. The Model TRN8872A VCO Interconnect (Feedthrough Plate) is mounted on the radio internal casting. J650 (on the rf board) is connected to one side of the plate and P650 (on the VCO board) is connected to the other. Feedthrough Filters FL1-FL7 act as pi-type filters in the lines connected through the plate.
6. Resistors marked with an asterisk (*) are screened directly upon the substrate and are not field replaceable.

Frequency Synthesizer Schematic Diagram
Motorola No. PEPS-30806-B
(Sheet 2 of 2)
1/15/81-PHI



SHOWN FROM SOLDER SIDE

*RF Board Circuit Board Detail and Parts Lists for Receiver, Preamplifier, and Internal Casting Motorola No. **PEPS-30807-A** (Sheet 1 of 2) 1/15/81-PHI*

parts list

TRN8868A Pre-Amplifier — PL-6992-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF; 50 V; unless otherwise stated
C101	21-84547A11	.01 uF ± 20%
C102	21-84873H68	43 ± 5%
C103	21-84873H56	8.2 ± .5 pF
C104	21-84736E24	1.8 ± .25 pF
C105, 106, 107	21-84873H88	43 ± 5%
C108, 109	21-84547A11	.01 uF ± 20%
C110	21-84873H77	12 ± 5%
C111, 112, 113	—	non-replaceable parts (note 2)
		diode: (see note I)
CR100	48-83510F06	silicon, current control
		coil, rf:
L103	24-82723H04	.29 uH
L105, 106	—	non-replaceable parts
		transistor: (see note 1)
Q101	48-869870	NPN; type M9870
Q102	48-84939C23	PNP; type M3903
		resistor, fixed:
R100 thru 108	—	non-replaceable parts (note 3)

TRN8873A Internal Casting Hardware Kit — PL-6994-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C114, 115	21-82812H06	feedthru, 1000 pF + 100-0%; 500 V
C153	21-82805H04	feedthru, 28 pF ± 10%; 200 V
C675	21-82543H01	feedthru, 1500 pF + 100-0%; 500 V
		coil, rf:
L100	24-80213B01	coded BRN; includes capacitor C100
L101	24-80213B02	coded RED
L110	24-80213B05	coded VIO
L111	24-80213B03	coded BLU
L112 thru 115	24-80213B04	coded NATURAL
L117	24-80213B08	coded GRN
L118	24-80213B07	coded YEL
L119	24-80213B06	coded ORN
		connector, plug: consists of:
P201	15-84301K01	HOUSING, connector; 3-position
	39-82717M01	CONTACT, receptable; 2 used
P600	28-82331G01	male, single contact
P700	28-82365D02	male, single contact
		resistor, fixed:
R100	6-185C04	100k ± 10%; 1/8 W

note:
1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
2. For parts not listed in the above parts list, refer to the mechanical parts section.

TRN8860A RF Board (Receiver Section) — PL-6993-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ± 5%; 100 V; unless otherwise stated
C200	21-11014H19	5.6 ± .5
C201	21-11015A07	.01 uF ± 80-20%
C202	21-11015B15	.0015 uF ± 10%
C203	21-11014H35	27
C204	21-11015B15	.0015 uF ± 10%
C205, 206	21-82450B13	1.5; 500 V
C207	21-82450B32	2.7; 500 V
C208	21-11014H32	20
C209	21-82450B48	0.75; 500 V
C210	21-11014N14	6.8 ± .25
C211	21-11014H48	91
C212	21-11015B15	.0015 uF ± 10%
C214	21-11015A07	.01 uF ± 80-20%
C215	21-11014H31	18
C216	21-82450B19	1.8 ± 5%; 500 V
C217	21-11015A07	.01 uF + 80-20%
C218	23-11013D55	4.7 uF ± 20%; 20 V
C219	21-11014H18	5.1 ± .5
C220	21-11015B15	.0015 uF ± 10%
C221	21-11014H19	5.6 ± .5
C222	21-11015B15	.0015 uF ± 10%
C223	21-11014H16	4.3 ± .25
C224	21-11015A07	.01 uF ± 80-20%
C225	21-11014H08	2.0 ± .25
C226	21-11015A07	.01 uF + 80-20%
C227	21-11014H34	24
C228	21-11015A07	.01 uF ± 80-20%
C229	21-11014H19	5.6
C230	21-82450B08	1.2; 500 V
C231	21-11014H19	5.6 ± .5
C232	21-11014H35	27
C233	21-11015B15	.0015 uF ± 10%
C234	21-11014H45	68
C235	21-11014H35	27 ± 5%
C236	21-11015B15	.0015 ± 10%
C237	21-11014H46	75
C238	21-11014H20	6.2 ± .5
C250	21-82450B37	.47; 500 V
C251	21-11014H35	27
C252	21-11014H40	43
C253, 254, 255	21-11014A07	.01 + 80-20%
C256	8-11017B17	0.1 ± 10%; 50 V
C257	21-11015A07	.01 + 80-20%
C258	21-11014H35	27
C259	21-11014H40	43
C260, 261	21-82450B08	1.2; 500 V
C262	21-82450B37	.47; 500 V
C263	21-11014H13	3.3 ± .25
C264	21-11014H33	22
C265	21-11014H35	27
C266	21-11014H39	39
C267 thru 273	21-11015A07	.01 + 80-20%
C274	21-11014H40	43
C275	21-11014H30	16
C276	21-11014H20	6.2 ± .5
C277	21-11015A07	.01 + 80-20%
C278	8-11017B17	0.1 ± 10%; 50 V
C279	21-11015A07	.01+ 80-20%
C280, 281	21-11015B09	470 ± 10%
C282	21-11015A07	.01 + 80-20%
CR200 thru 203	48-83654H01	**diode: (see note)** silicon
		connector, receptacle:
J200	28-84324M01	male, 2-contact
J201	28-84324M02	male, 3-contact
J202	42-83891L01	female, single contact
J203	9-84207B01	female, 7-contact
J204 thru 207	42-83891L01	female, single contact
		coil, rf:
L200	24-82723H04	0.29 uH
L201	24-82723H07	10 uH
L202	24-83397L12	1.2 uH
L203	24-82723H07	10 uH
L204	24-83397L12	1.2 uH
L205	24-83397L13	0.82 uH
L206	24-82723H13	.065 uH
L207	24-82723H05	0.41 uH
L208, 209	24-82723H07	10 uH
L210	24-83397L13	0.82 uH
L211	24-83397L12	1.2 uH
L212	76-83960B01	ferrite bead
L213	24-82835G41	5.6 uH
L214	24-82723H05	410 nH
L215	24-82723H06	6.2 uH
L216	24-82723H07	10 uH
L217	24-83397L08	15 uH
L250	24-83397L07	30 uH
L251	24-82723H07	10 uH
L252	24-83397L07	10 uH
L253, 254, 255	24-83397L08	15 uH
L256, 257	24-82723H07	10 uH

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, plug:
P202	—	p/o feedthru capacitor C153
		transistor: (see note)
Q200	48-869643	PNP; type MPA9
Q201, 202	48-869839	N-channel FET; type M9839
Q203	48-84412L21	Dual Gate MOSFET; type M1212
Q204	48-869932	NPN; type MPA39
Q250	48-869643	PNP; type M9643
		resistor, fixed: ± 5%; 1/4 W:
R200	6-11008A41	470
R201	6-11008A89	47k
R202	6-11008A73	10k
R203	6-11008A85	4.7k
R204	6-11008A27	120
R205	6-11008A59	2.7k
R206	6-11008A27	120
R207	6-11008A01	10
R208	6-11008A57	2.2k
R209	6-11008A51	1.2k
R210	6-11008A59	2.7k
R211	6-11008A73	10k
R212	6-11008A35	270
R213	6-11008A93	68k
R214	6-11008A59	2.7k
R215	6-11008A48	1k
R216	6-11008A65	4.7k
R217	6-11008A41	470
R250	6-11008A93	68k
R251	6-11008A01	10
R252	6-11008A41	470
R253	6-11008A01	10
R254	6-11008A93	68k
R255	6-11008A41	470
R256, 257	6-11008A93	68k
R258	6-11008A99	120k
R259	6-11008A41	470
R260	6-11008A89	47k
R261	6-11008A73	10k
R262	6-11009B06	180k
R263	6-11008A73	10k
R264	6-11008A48	1k
R265	6-11008A79	18k
R266	6-11008A48	1k
		integrated circuit: (see note)
U250	51-84621K90	if-amp; type MJ590
U251	51-84561L84	limiter/quadrature detector; type M6184
		crystal:
Y200	48-83742M01	filter, 53.9 MHz
Y250	48-84396K05	resonator, 10.7 MHz
Y251	48-84396K01	resonator, 10.7 MHz
Y252, 253, 254	48-84396K02	resonator, 10.7 MHz

TRN8869A First Mixer — PL-7026-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C150	21-82450B10	4.3 pF ± 5%; 100 V
C151	21-82187B11	1500 pF + 10%; 100 V
C152	21-861603	3.3 pF ± .25 pF; NPO
		diode: (see note)
CR150, 151	48-84616A06	hot carrier p/o 1-80724D26
CR152	48-84616A01	hot carrier
		coil, rf:
L151	24-84235B08	1-1/2 turns
L153	24-82723H04	choke; 29 uH
		resistor, fixed:
R150	6-11008A89	47k ± 5%; 1/8 W
		non-referenced item
	1-80724D26	includes CR150, 151
	29-84985K01	TERMINAL, 4 used

TRUNKED SYNTOR X RECEIVER

1. DESCRIPTION

1.1 The Trunked SYNTOR X radio is a dual-conversion receiver with intermediate frequencies of 53.9 MHz and 10.7 MHz. The factory-tuned preselector filter is sufficiently wide to accommodate all frequencies within the 851 MHz to 870 MHz band without retuning.

1.2 The receiver circuits are located in the internal casting and on the rf board, personality board, and the common circuits board.

2. THEORY OF OPERATION

2.1 INTRODUCTION

2.1.1 The incoming rf signals are applied to the rf preamplifier via the antenna relay and a 2-pole preselector filter. When the radio is in the transmit mode, dc power is removed from the preamplifier, and any transmitter power leaking through the open receive reed is shunted to ground by means of a PIN diode switch. The preamplifier output passes through a 6-pole preselector filter and is then applied to the first mixer stage. The selectivity of the 2-pole and 6-pole preselector filters is such that it prevents high-level, out-of-band signals from degrading receiver performance.

2.1.2 The frequency synthesizer rf output is doubled and then applied to the first mixer via a 3-pole injection filter. The first mixer, which is a balanced diode type, uses low-side injection to generate a first intermediate frequency (i-f) of 53.9 MHz.

2.1.3 The 53.9 MHz i-f signal is coupled from the first mixer to the rf board and is then applied to the first i-f amplifier. This amplifier uses a JFET in a common-gate configuration. The amplified output signal passes through a 53.9 MHz two-pole crystal filter and is applied to a second i-f amplifier. This amplifier also uses a JFET in a common-gate configuration. The i-f signal is sufficiently amplified by the second i-f amplifier so that it will have sufficient level to drive the second mixer.

2.1.4 The output of the frequency synthesizer's 14.4 MHz reference oscillator is split and part of the power is applied to the injection tripler. The injection tripler uses a class-C-driven bipolar transistor amplifier to generate the required harmonics. The injection tripler output is turned at a fixed injection frequency of 43.2 MHz. The second mixer uses the two input signals to generate a second intermediate frequency of 10.7 MHz. Low-side injection is also used in the second mixer.

2.2 SECOND I-F CIRCUITRY

2.2.1 Several stages of filtering and amplification are employed in the second i-f circuitry. Selective i-f filtering is achieved by using dual-resonator, mode-coupled monolithic crystals cut to a fundamental frequency of 10.7 MHz. No tuning is required in the second i-f or detector circuitry.

2.2.2 The second mixer's output is applied to the first 4-pole filter (Y250-Y251) via a matching network, and the output of the first 4-pole filter is applied to a matching network and then to a high-gain (approximately 45 dB) second i-f amplifier (U250). The output of the second i-f amplifier is applied to a matching network, a second 4-pole filter (Y252-Y253), a final matching circuit, and the limiter/detector (U251).

2.3 LIMITER/DETECTOR

The limiter/detector (U251) provides a limiting function and a means for recovering audio from the frequency-modulated carrier. Audio is recovered from the second i-f signal by means of a quadrature detector internal to the limiter/detector and an external two pole dual resonator crystal. The recovered audio from the limiter/detector output passes through an emitter-follower buffer (Q250) and is then routed to the audio stages on the personality board. This detector buffer provides approximately 550 millivolts to the control head.

2.4 AUDIO

2.4.1 Detected audio is applied to the control head for application to the volume control. The adjustable output of this voltage divider is then routed to the radio for application to the audio circuits.

2.4.2 The incoming signals are buffered and filtered by the filter/audio shaping stages. These stages consist of quad operational amplifier U440 and associated circuitry up to the input of the audio driver (U441). The audio power amplifier consists of audio driver U441, the driver transistor pairs, and the class-B complementary audio finals, Q448 and Q449. The audio power amplifier amplifies the filtered audio signal, and the amplified audio signal is then transformer-coupled to the external speaker. The alert tones generated by the microprocessor are routed through the volume wiper in the control head and then injected into the filter/audio shaping stages.

2.5 RECEIVER METERING SOCKET

The receiver metering socket permits the following measurements to be made:

- MS1 (pin 1 of the metering socket) provides an indication of the i-f signal frequency relative to the quadrature detector center frequency.

NOTE

This should not be used for "warping" the radio on frequency.

- MS2 permits monitoring the i-f signal level at the input of the limiter/detector.
- MS3 allows monitoring of the second mixer bias current, the proper injection level, and the high-level rf signals.
- MS4 allows the measurement of the strength of the 14.4 MHz signal generated by the reference oscillator.
- MS5 permits monitoring the relative strength of the first mixer injection signal.

3. RECEIVER TROUBLESHOOTING PROCEDURE

This procedure facilitates the location of the cause of loss of sensitivity in the Trunked SYNTOR X radio. Refer to the list of recommended test equipment provided in the General Maintenance section of this manual.

Step 1. Perform the preliminary checks provided in Table 1. If all the meter indications are correct, go to Step 2.

Step 2. Apply a 20-millivolt signal to the antenna connector. If the meter indication at M250-4 rises above 40 uA, check the low i-f (intermediate frequency) and quad detector.

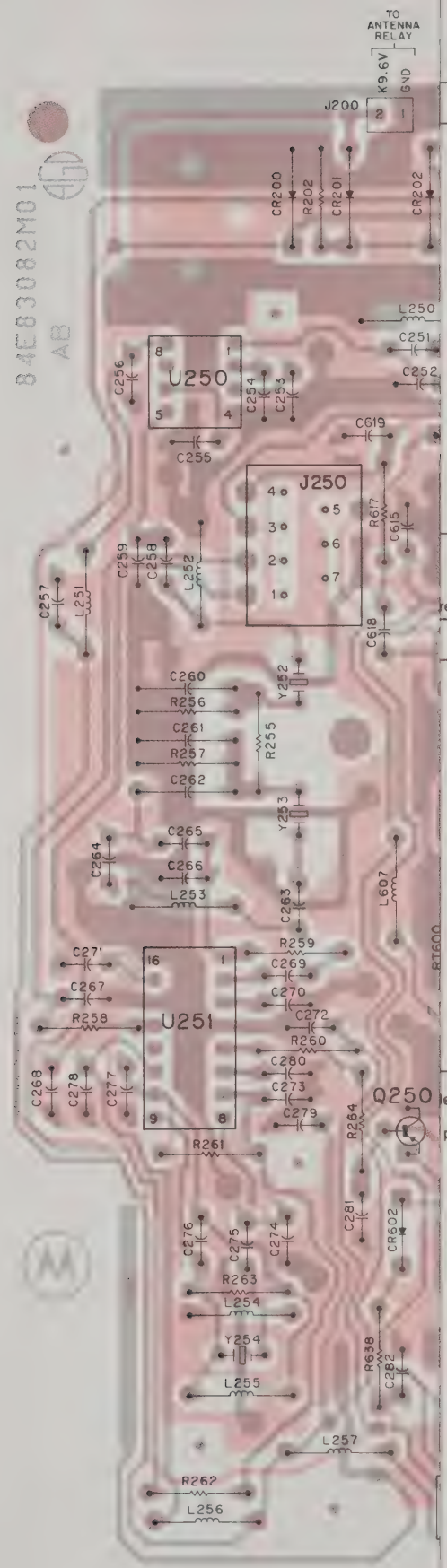
NOTE

Troubleshooting of the low i-f and detector is facilitated by referring to the meter voltages, rf voltages, and dc voltages provided in the receiver schematic diagram located at the end of this section.

Receiver Preliminary Checks

Pin on Metering Socket (J203) on RF Board	Normal Indication	I-F Indication is Incorrect
M250-1	25 + 5 microamperes (uA)	Check the low i-f and quad detector. (See note below).
M250-2	a. (without signal) 15 ± 5 uA; b. (with 20 dBq signal) should be 3 to 6 uA above first signal.	Go to Step 2 below.
M250-3	a. 30 ± 5 uA;	a. Check Q203 dc voltages.
	b. (When base of Q204 is shorted) should be 2 to 3 uA above first signal.	b. Check Q203 and Q204 dc voltages.
M250-4	Greater than 10 uA	Check reference oscillator output level.
M250-5	Greater than 20 uA (meter may be pegged)	Check mixer diodes and VCO power at transmitter input.

If the meter indication at M250-4 is less than 40 uA, check the dc voltages of the preamplifier and the high i-f (Q201, Q202, Q203, and Q204)



DESCRIPTIO

capacitor, fixed: pF; 50 V:
unless otherwise stated
.01 uF ± 20%
43 ± 5%
8.2 ± .5 pF
1.8 ± .25 pF
43 ± 5%
.01 uF ± 20%
12 ± 5%
non-replaceable parts (note

diode: (see note I)
silicon, current control

coil, rf:
.29 uH
non-replaceable parts

transistor: (see note 1)
NPN; type M9870
PNP; type M3923

resistor, fixed:
non-replaceable parts (note

re Kit

DESCRIPTIO

capacitor, fixed:
feedthru, 1000 pF + 100-0%;
feedthru, 28 pF ± 10%; 200 V
feedthru, 1500 pF + 100-0%;

coil, rf:
coded BRN. includes capaci
coded RED
coded VIO
coded BLU
coded NATURAL
coded GRN
coded YEL
coded ORN

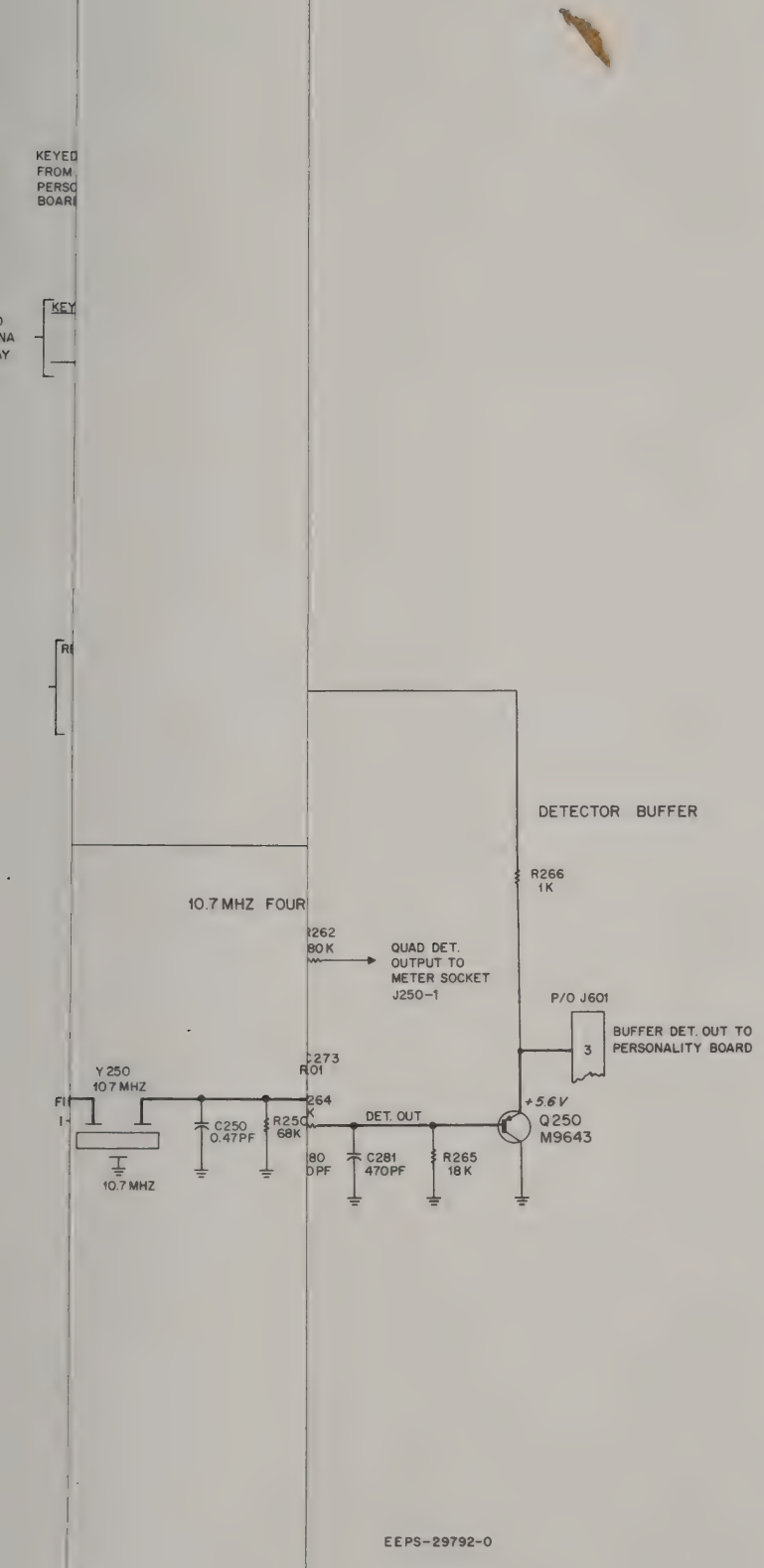
connector, plug:
consists of:
HOUSING, connector; 3-p
CONTACT, receptable; 2 u
male, single contact
male, single contact

resistor, fixed:
100k ± 10%; 1/8 W

es, transistors, and integrate

parts list, refer to the mechan

RF Board Circuit Board Detail and Parts Lists for Receiver, Preamplifier, and Internal Casting Motorola No. ***PEPS-30807-A***
(Sheet 1 of 2)
1/15/81-PHI

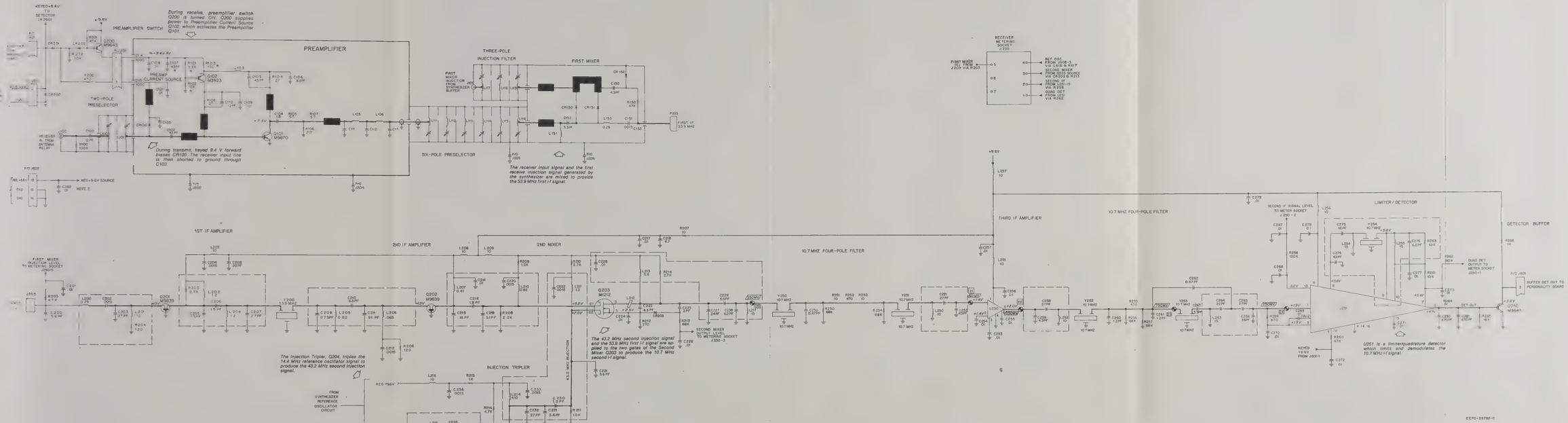


NOTES.

1. Unless otherwise stated, all resistor values are in ohms, all capacitor values are in microfarads, all inductor values are in microhenries.
2. Pins J602-15, J602-16, and J602-18 and capacitor C282 are common to the receiver and synthesizer sections of the radio. These components appear on both the receiver and synthesizer schematic diagrams.

Receiver Metering		
Meter #	Function	Normal Indication (Approx.)
1	Quadrature detector center frequency	25 uA
2	2nd i-f signal level into limiter/detector	Idle 15 uA @ 20 dBq increases 5 uA
3	Second mixer with injection	30 uA
	With no injection (short base of Q204 to GND)	Increases 2-3 uA
4	Reference oscillator	15 uA
5	1st Mixer injection level	20 uA

Receiver Schematic Diagram
Motorola No. PEPS-30807-A
(Sheet 2 of 2)
1/15/81-PHI



NOTE

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3	Second mixer with injection With no injection (short base of Q204 to GND)	30 uA increases 2-3 uA
4	Reference oscillator	15 uA
5	1st Mixer injection level	20 uA

Receiver Schematic Diagram
Motorola No. PEPS-30807-A
(Sheet 2 of 2)
1/15/81-PHI

RECEIVER

TRUNKED SYNTOR X TRANSMITTER

1. THEORY OF OPERATION

1.1 Microstrip design employing ceramic substrate boards has been used in the Trunked SYNTOR X Mobile Transmitter. All the transmitter stages consist of 50-ohm blocks with class-C amplifier circuitry. The transmitter comprises two major sections: the intermediate power amplifier (IPA) and the power amplifier (PA).

1.2 The rf output generated by the frequency synthesizer at the required transmit carrier frequency is applied to the controlled stage of the IPA (Q700). The gain of the controlled stage and the output power of the radio can be changed by varying the control voltage. The IPA output stage (Q701) is driven by the controlled stage. DC power for the IPA output stage is supplied via the output coaxial cable. The IPA module has a rated output power of 1.2 W.

1.3 The rf signal passes from the IPA to the final power amplifier via a coaxial cable and is then applied to the predriver stage (Q750), which is followed by the driver stage (Q800). The predriver and driver stages, which are mounted on separate microstrip assemblies, can provide 4.5 W and 18 W outputs, respectively.

1.4 The final power amplifier contains two power transistors (Q850 and Q851) which operate in parallel. The transmitter is provided with temperature-sensing circuitry that protects the final power amplifier against damaging high temperatures. The temperature-sensing circuitry, located on the final power amplifier, works in conjunction with the power control circuits to reduce the radio output power whenever the transistor temperature exceeds 80°C.

1.5 The rf power output from the final amplifier module is applied to a directional coupler. The directional coupler is used to measure both the forward and reflected power. Information related to the forward and reflected power is relayed to the power control circuitry located on the common circuits board. The power control circuits react to any change in power by causing a change in the rf drive in such a direction as would restore the rf power output to its original level.

1.6 When the VSWR (voltage standing wave ratio) at the radio output connector approaches a level that can damage the final power transistors, the power control circuitry reacts by reducing the rf power output to a predetermined safe level (6 W to 10 W). The directional coupler rf output is routed to the antenna via a harmonic filter and the antenna relay. The rf output power at the directional coupler is at least 50 W.

1.7 The transmitter is provided with a metering socket (J1101) that facilitates the following measurements:

- J1101-1 and J1101-2 (pins 1 and 2 of the metering socket) permit checking of the directional coupler outputs. J1101-1 provides a dc voltage proportional to the forward power level, and J1101-2 provides a dc voltage proportional to the reflected power level.
- In the transmitter, rf detectors are located at the input of each stage. All of the rf detectors are used in conjunction with metering socket pin 3 (J1101-3). When the rf input to any stage is to be measured, a jumper is used to connect J1101-3 to the rf detector of the stage being checked.
- J1101-4 is used to measure the transmitter supply voltage.

2. POWER AMPLIFIER TROUBLESHOOTING PROCEDURE

2.1 PREREQUISITE TEST SET-UP

NOTE
Refer to the list of Recommended Test Equipment provided in the Maintenance section of this instruction manual.

Step 1. Connect the radio antenna connector to a wattmeter terminated in a 50-watt dummy load. Be sure that the wattmeter, load, and interconnect cable are rated for use at 800 MHz.

Step 2. Connect the radio to a 13.6 volt dc power supply capable of supplying at least the maximum transmit current specified for your radio.

Step 3. Using a TEK-37 Test Set Adapter, connect a Motorola S1056 Portable Test Set to the radio as follows:

- Connect the 20-pin connector of the test set adapter to the receptacle on the front panel of the portable test set.
- Connect the white "metering" plug of the test set adapter to the power amplifier metering receptacle.

Step 4. Set the portable test set switches as follows:

- Set the FUNCTION switch to the XMTR position.
- Set the METER switch to the REV position.
- Set the test set adapter REF switch to position A.
- Set the test set adapter 1V-100 mV switch to the 100 mV position. (If the test set adapter is not provided with such a switch, the unit operates at 100 mV at all times.)

Step 5. Before operating any equipment, refer to the CAUTION provided on the power amplifier troubleshooting chart (DEPS-30266) and make sure that all ac operated test equipment units are isolated from the ac line ground.

Step 6. Because of power control shutback function, the power amplifier output power may range between 5 W and 10 W. Refer to the power amplifier power setting procedure to determine whether or not shutback is occurring.

2.2 INTERPRETATION OF DATA PROVIDED IN POWER OUTPUT TABLE

2.2.1 Refer to the power output table shown in the troubleshooting chart. This table provides typical (not absolute) meter readings along with power control voltages and total current levels for different power outputs. This table can be used to determine when the performance of a power amplifier module has deteriorated below accepted levels. This can be done as follows:

- Turn the power control potentiometer (R980) fully clockwise.
- Set the power output to a low level.
- Take the various meter readings required and compare them with those provided in the table. For a 5-watt power output, for example, the table provides the following:

POWER CONTROL VOLTAGE:	2.44 V
TOTAL RADIO CURRENT:	3.7A
MS1:	4.0 uA
MS2:	0 uA
IPA1/MS3:	27 uA
IPA2/MS3:	11 uA
PREDRIVER/MS3:	16 uA
DRIVER/MS3:	10 uA
FPA/MS3:	13 uA

NOTE

The readings obtained from a degraded module will be lower than the typical readings provided by the table.

2.2.2 When the gain of a power amplifier module stage degrades, the power control circuit will attempt to increase the power level; this results in providing more drive power to the modules preceding the faulty stage.

2.2.3. It will be noted from the table that MS3 (pin #3 of the PA metering socket) is associated with IPA1, IPA2, PD, DR, and FPA (refer to the abbreviations provided on the troubleshooting chart). The various MS3 readings can be obtained by referring to Figure 1, which shows the various MS3 connections.

2.3 TROUBLESHOOTING PROCEDURE

Step 1. Refer to the symbols and abbreviations provided on the power amplifier troubleshooting chart, as well as to the CAUTION and typical meter readings table contained on the diagram.

Step 2. Follow the step-by-step procedure outlined on the troubleshooting chart.

3. RF POWER CONTROL TROUBLESHOOTING PROCEDURE

The rf power control troubleshooting procedure consists (as shown in the associated troubleshooting charts) of:

- insufficient power output
- lack of power control
- VSWR protection
- low-line cutback
- high-drive protection

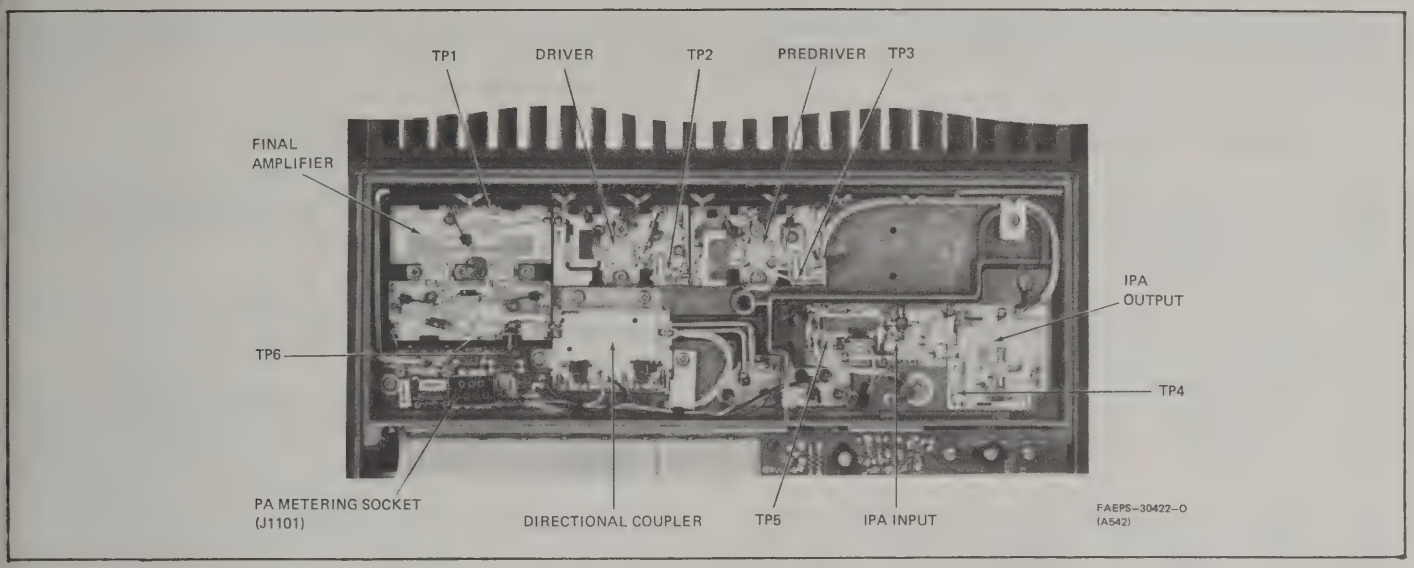


Figure 1. Power Amplifier MS3 Connections

NOTE

Since the critical voltages in the power control exist only during transmit conditions, briefly key the transmitter during the test and take the required measurement. Avoid any continuous keying of the transmitter since such keying can place the power control into protective shutback, thus causing the generation of erroneous and confusing symptoms.

NOTE

All voltage measurements are referenced to A-.

3.1 INSUFFICIENT POWER OUTPUT

Step 1. Perform the steps specified in the insufficient power output section of the RF Power Control troubleshooting chart (EEPS-30120).

Step 2. After locating and correcting the fault, it is highly recommended that the following procedures be performed:

- VSWR protection
- low-line cutback
- high-drive protection

3.2 LACK OF POWER CONTROL

If there is sufficient power output but it is impossible to adjust the power control, proceed as follows:

Step 1. Perform the steps specified in the lack of power control troubleshooting chart (EEPS-30120).

Step 2. After locating and correcting the fault, it is highly recommended that the following three procedures be performed:

- VSWR protection
- low-line cutback
- high-drive protection.

NOTE

When the power amplifier fails, it is very probable that the power control protection functions are not operating properly. Consequently, it is recommended that the following three procedures be performed. These procedures (as explained above) should also be performed after completing the insufficient power output procedure or the lack of power control procedure.

3.3 VSWR PROTECTION TEST

Step 1. Use the standard test set-up outlined in the paragraph dealing with the power amplifier troubleshooting procedure.

Step 2. Verify that the radio is terminated in a 50-ohm load as explained in the test set-up.

Step 3. Briefly key the transmitter and adjust the POWER SET potentiometer (R980) until a power output indication of 38 W $\pm$ 1.5 W is obtained on all channels.

NOTE

Avoid extended keying of the transmitter as explained previously.

Step 4. Remove the 50-ohm load from the radio. Briefly key the transmitter again and verify that an output power indication of approximately 6.3 W (one-sixth of the nominal output power) is obtained on all channels. Also verify that the voltage indication on U951-8 (i.e., pin 8 on U951) is greater than 7 V. If either or both

indications are incorrect, refer to the VSWR protection troubleshooting chart and perform the steps outlined in this chart.

3.4 LOW-LINE CUTBACK TEST

Step 1. Use the standard test set-up provided in the paragraph dealing with the power amplifier troubleshooting procedure.

Step 2. Verify that the radio is terminated in a 50-ohm load. Set the power supply output voltage to 13 V. Briefly key the transmitter and adjust the POWER SET potentiometer (R980) until an output power indication of 38 W is obtained on all channels.

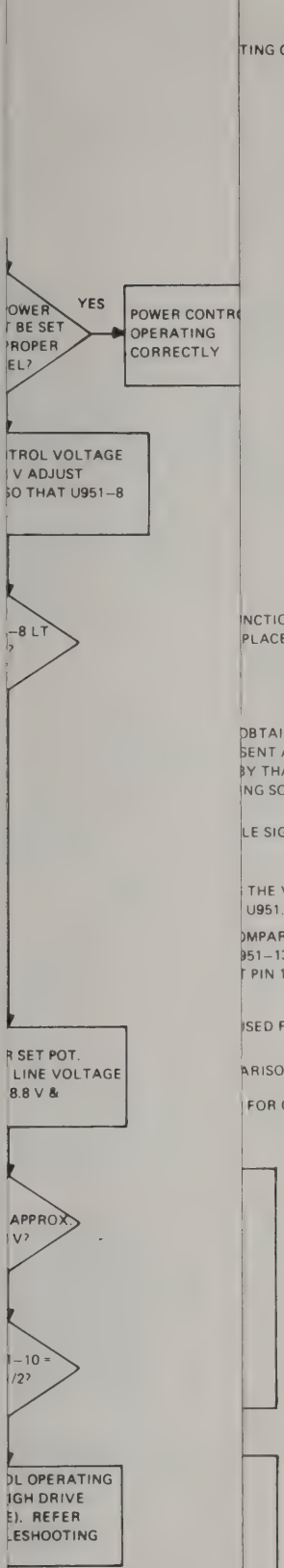
Step 3. Dekey the transmitter and reduce the power supply voltage to 10.7 V. Rekey the transmitter and verify that the output power is 20 W on all channels. If an incorrect output power indication is obtained, perform the steps outlined in the low-line protection troubleshooting chart.

3.5 HIGH-DRIVE PROTECTION TEST

Step 1. Use the standard test set-up outlined in the paragraph dealing with the power amplifier troubleshooting procedure.

Step 2. Verify that the radio is terminated in a 50-ohm load. Set the power supply voltage to 13 V.

Step 3. With the transmitter dekeyed, disconnect plug J1. Key the transmitter and verify that the POWER SET voltage provides an indication of 1.1 V is obtained between 1 to 2.5 V is the nominal power set voltage. If the POWER SET voltage indication is incorrect, refer to the high-drive protection troubleshooting chart and perform the steps outlined in this chart.



RF Power Control Troubleshooting Chart
Motorola No. ***EEPS-30120-O***
7/30/80-PHI

indications are incorrect, refer to the VSWR protection troubleshooting chart and perform the steps outlined in this chart.

3.4 LOW-LINE CUTBACK TEST

Step 1. Use the standard test set-up provided in the paragraph dealing with the power amplifier troubleshooting procedure.

Step 2. Verify that the radio is terminated in a 50-ohm load. Set the power supply output voltage to 13 V. Briefly key the transmitter and adjust the POWER SET potentiometer (R980) until an output power indication of 38 W is obtained on all channels.

Step 3. Dekey the transmitter and reduce the power supply voltage to 10.7 V. Rekey the transmitter and verify that the output power is 20 W on all channels. If an incorrect output power indication is obtained, perform the steps outlined in the low-line protection troubleshooting chart.

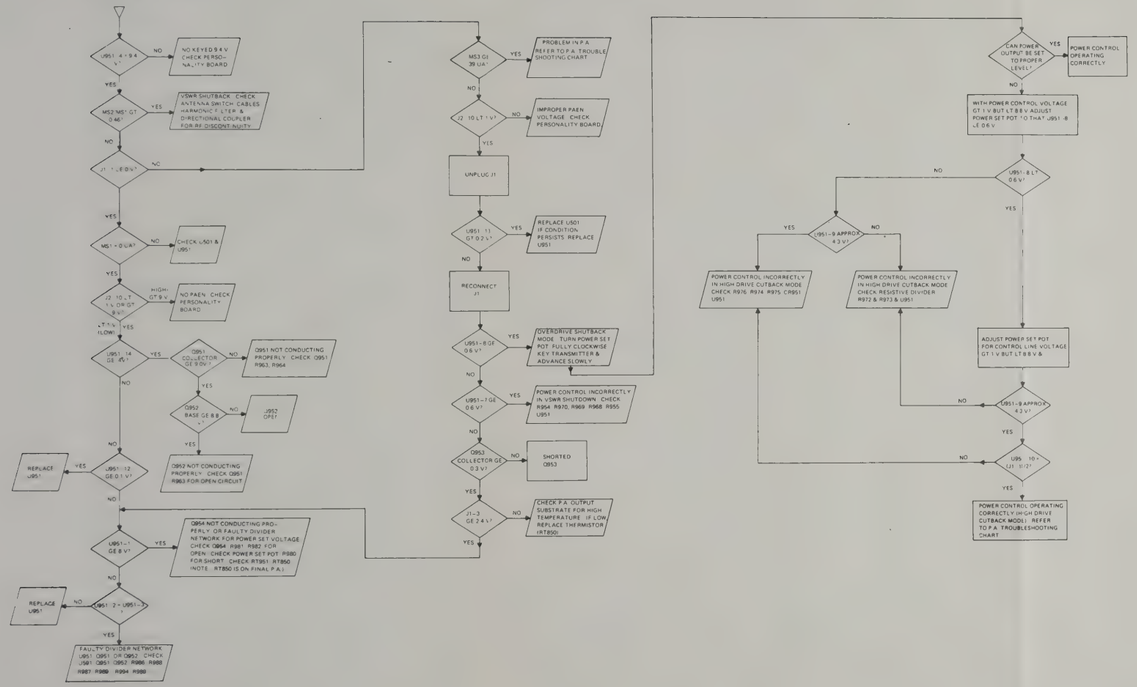
3.5 HIGH-DRIVE PROTECTION TEST

Step 1. Use the standard test set-up outlined in the paragraph dealing with the power amplifier troubleshooting procedure.

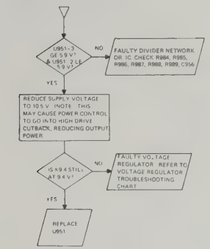
Step 2. Verify that the radio is terminated in a 50-ohm load. Set the power supply voltage to 13 V.

Step 3. With the transmitter dekeyed, disconnect plug J1. Key the transmitter and verify that the POWER SET voltage provides an indication of 1.1 V is obtained between 1 to 2.5 V is the nominal power set voltage. If the POWER SET voltage indication is incorrect, refer to the high-drive protection troubleshooting chart and perform the steps outlined in this chart.

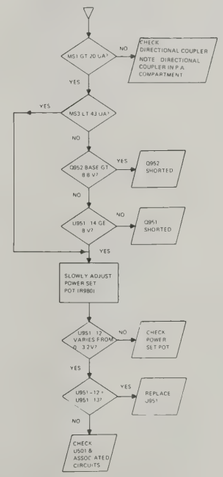
INSUFFICIENT POWER OUTPUT TEST PROCEDURE



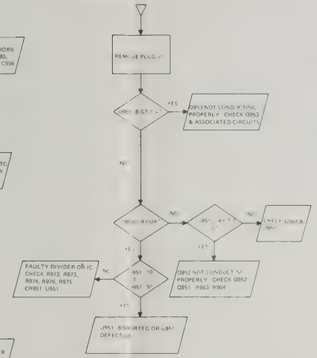
LOW-LINE CUTBACK TEST PROCEDURE



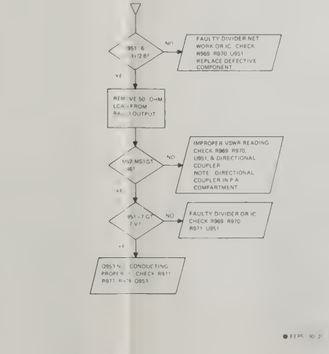
LACK OF POWER CONTRO... TEST PROCEDURE



HIGH DRIVE PROTECTION TEST PROCEDURE

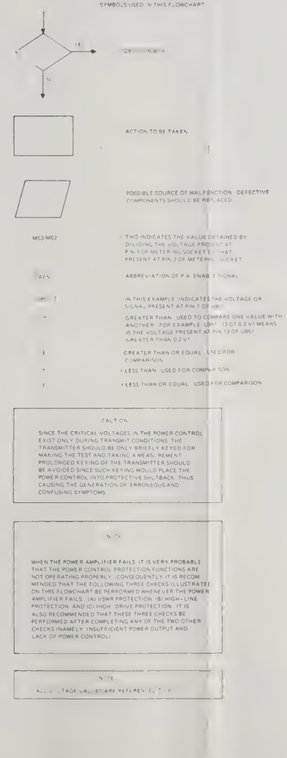


VSWR PROTECTION TEST PROCEDURE



SYNTOR X POWER CONTROL TROUBLESHOOTING CHART

SYMBOLS USED IN THIS FLOWCHART



CAUTION

SINCE THE CRITICAL VOLTAGES IN THE POWER CONTROL EXIST ONLY DURING TRANSMIT CONDITIONS THE TRANSMITTER SHOULD BE ONLY BRIEFLY KEYED FOR MAKING THE TEST AND TAKING A READ REMENT PROLONGED KEYING OF THE TRANSMITTER SHOULD BE AVOIDED SINCE SUCH KEYING WOULD PLACE THE POWER CONTROL INTO PROTECTIVE SHUTBACK THUS CAUSING THE GENERATION OF ERRONEOUS AND CONFUSING SYMPTOMS

NOTE

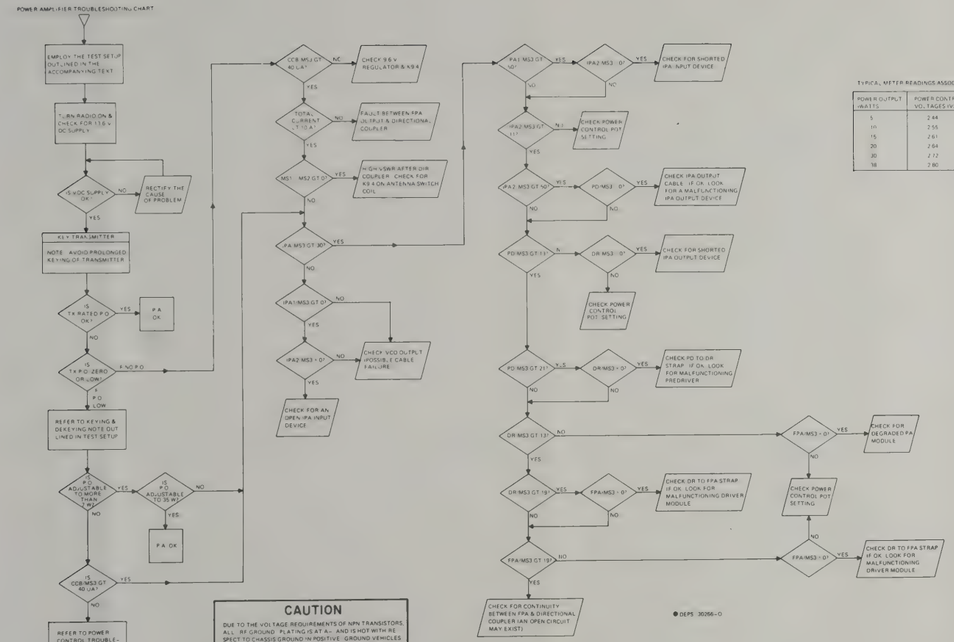
WHEN THE POWER AMPLIFIER FAILS IT IS VERY PROBABLE THAT THE POWER CONTROL PROTECTION FUNCTIONS ARE NOT OPERATING PROPERLY CONSEQUENTLY IT IS RECOMMENDED THAT THE FOLLOWING THREE CHECKS ILLUSTRATED ON THIS FLOWCHART BE PERFORMED WHENEVER THE POWER AMPLIFIER FAILS (A) VSWR PROTECTION (B) HIGH-LINE PROTECTION AND (C) HIGH DRIVE PROTECTION IT IS ALSO RECOMMENDED THAT THESE THREE CHECKS BE PERFORMED AFTER COMPLETING ANY OF THE TWO OTHER CHECKS (NAMELY INSUFFICIENT POWER OUTPUT AND LACK OF POWER CONTROL)

NOTE

ALL VOLTAGE VALUES ARE REFERENCED TO [illegible]

TRANSMITTER

RF Power Control Troubleshooting Chart
Motorola No. EEPS-30120-O
7-30-80-PHI



CAUTION

DUE TO THE VOLTAGE REQUIREMENTS OF NPN TRANSISTORS, ALL RF GROUND PLATING (CAT A-, AND IS NOT WITH RESPECT TO CHASSIS GROUND IN POSITIVE GROUND VEHICLES BECAUSE OF THIS, CAUTION SHOULD BE USED TO PREVENT CONNECTION OF GROUND PLATING ON THE POWER AMPLIFIER TO CHASSIS GROUND, EITHER DIRECTLY, OR BY THE USE OF TEST EQUIPMENT GROUND LEADS. IF AC OPERATED TEST EQUIPMENT IS USED, THE GROUND LEAD MUST NOT BE ELECTRICALLY CONNECTED TO AC LINE GROUND.

TYPICAL METER READINGS ASSOCIATED WITH DIFFERENT POWER OUTPUT LEVELS

POWER OUTPUT (WATTS	POWER CONTROL VOLTAGES (V)	TOTAL RADIO CURRENT (A)	P.A. METERING SOCKET READINGS (IN MICROAMPS)						
			MS1	MS2	IPA1/MS3	IPA2/MS3	PO/MS3	DR/MS3	FPA/MS3
5	2.44	3.7	4.0	0	21	11	18	10	13
10	2.55	5.0	6.0	0	36	11	17	10	15
15	2.61	6.2	10.0	0	37	12	17	11	16
20	2.64	7.0	12.0	0	17	13	17	13	17
30	2.72	8.5	15.0	0	31	13.5	18	15	19
38	2.80	9.6	18.0	0	17	14	18	16	22

SYMBOLS AND ABBREVIATIONS USED IN THIS FLOWCHART

DECISION BOX

ACTION TO BE TAKEN

- POSSIBLE LOCATION OF FAULT. DEFECTIVE COMPONENTS TO BE REPLACED

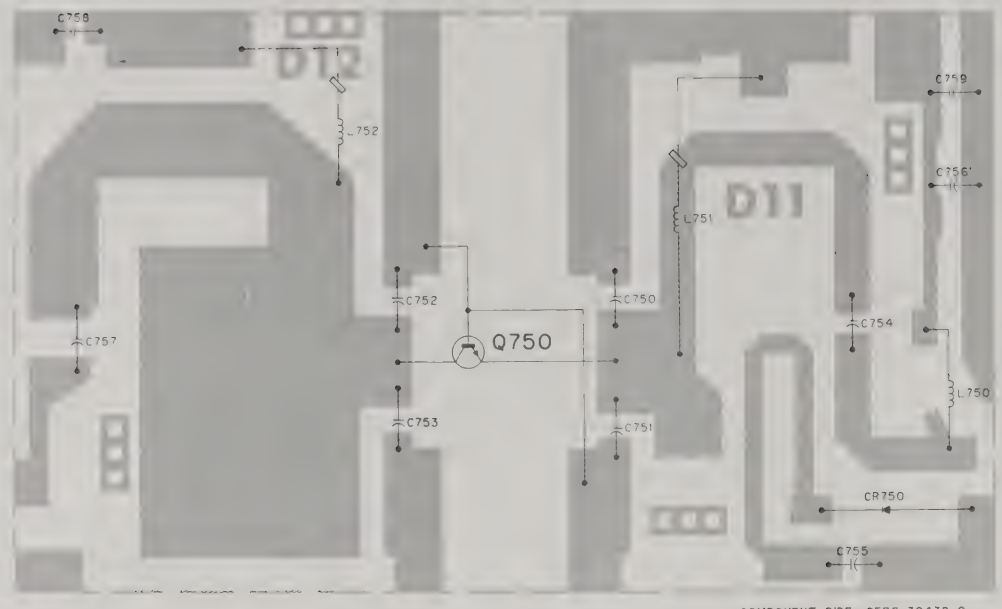
P.O. POWER OUTPUT
P.A. POWER AMPLIFIER
FPA FINAL POWER AMPLIFIER
IPA INTERMEDIATE POWER AMPLIFIER
IPA1 INTERMEDIATE POWER AMPLIFIER NO. 1
IPA2 INTERMEDIATE POWER AMPLIFIER NO. 2
PO PREDRIVER
DR DRIVER
CCB COMMON CIRCUIT BOARD
MS3 PIN NO. 3 OF THE METERING SOCKET

IPA1/MS3 PIN NO. 3 OF METERING SOCKET ASSOCIATED WITH INTERMEDIATE P.A. NO. 1. THE METERING SOCKET IS LOCATED ON P.A. BOARD. OTHERS ARE (PA2/MS3, FPA/MS3, PO/MS3, DR/MS3).

CCB/MS3 PIN NO. 3 OF METERING SOCKET LOCATED ON THE COMMON CIRCUITS BOARD.

GT GREATER THAN. USED FOR COMPARISON
GE GREATER THAN OR EQUAL. USED FOR COMPARISON
LT LESS THAN. USED FOR COMPARISON
LE LESS THAN OR EQUAL. USED FOR COMPARISON

PREDRIVER



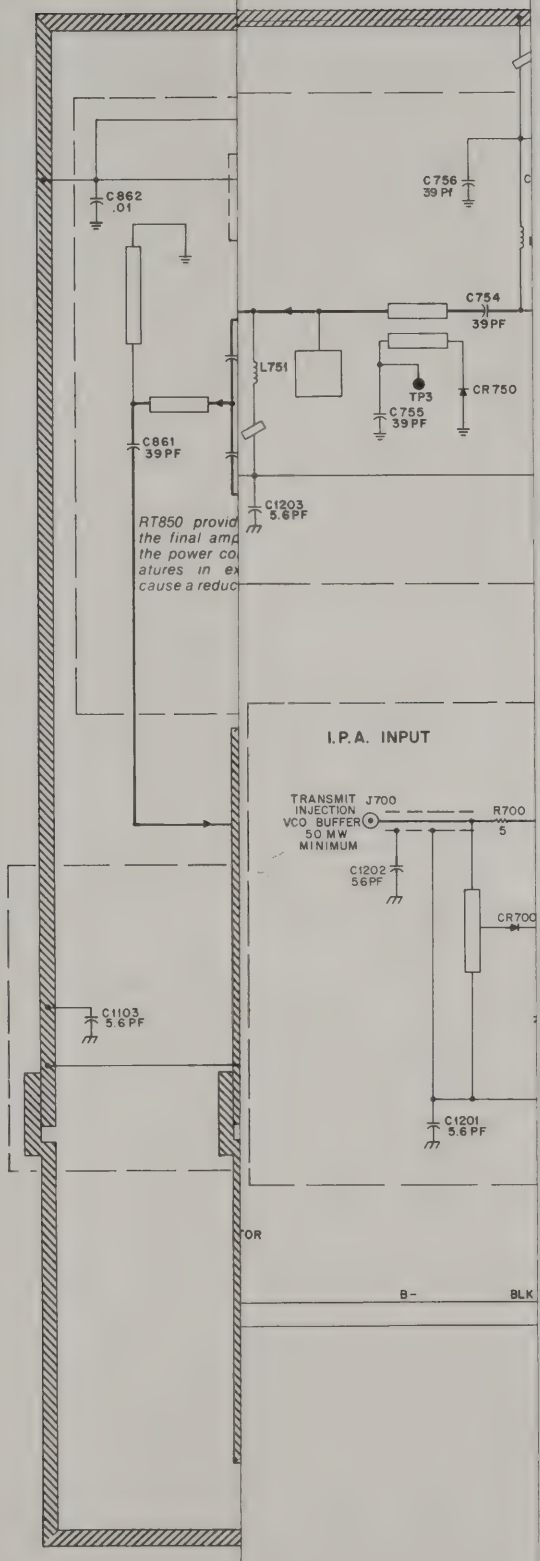
COMPONENT SIDE - CEPS-30438-O
OL - CEPS-30439-O

SHOWN FROM COMPONENT SIDE

NOTE

Substrates are not field repairable. Order replacement by Kit Number, TRN8XXX.

Power Amplifier Deck Schematic Diagram, and Substrates
Motorola No. ***PEPS-30808-A***
(Sheet 1 of 2)
1/15/81-PHI

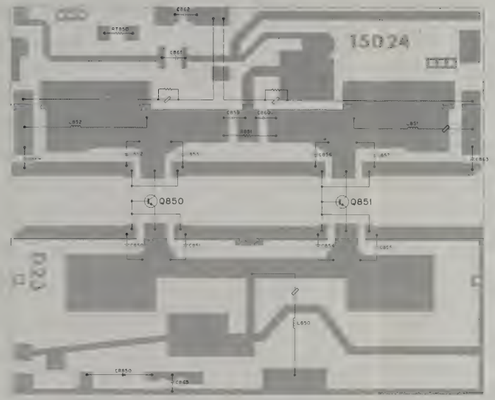


ates Power Amplifier Deck Schematic Diagram &
*ola No. **PEPS-30808-A***
2 of 2)
-PHI

PREDRIVER

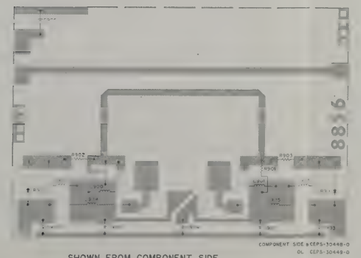
SHOWN FROM COMPONENT SIDE

FINAL PA



SHOWN FROM COMPONENT SIDE

DIRECTIONAL COUPLER

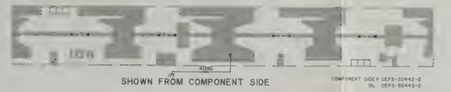


SHOWN FROM COMPONENT SIDE

NOTE
Substrates are not field repairable. Order replacement by Kit Number, TRN8XXX.

Power Amplifier Deck Schematic Diagram, and Substrates
Motorola No. PEPS-30808-A
(Sheet 1 of 2)
1-15-81-PHI

HARMONIC FILTER

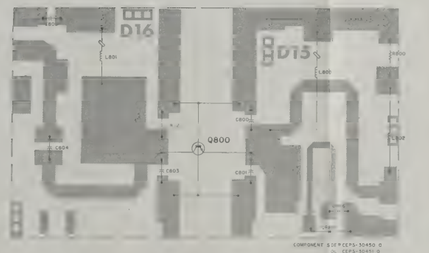


SHOWN FROM COMPONENT SIDE

IPA INPUT

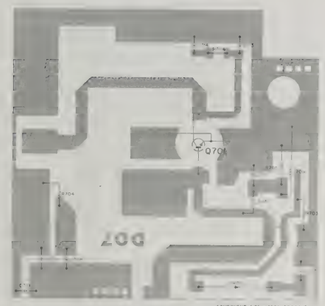
SHOWN FROM COMPONENT SIDE

DRIVER



SHOWN FROM COMPONENT SIDE

IPA OUTPUT



SHOWN FROM COMPONENT SIDE

parts list

TRN8858A Power Amplifier Hardware Kit — PL-7036-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed
C1180 thru 1187, C1200, 1202, 1203, 1204, 1205	21-82812H03 21-83406D64	feedthru, .001 µF ± 100-0%, 500 V 5.6 pF ± .25 pF, 500 V
		connector, plug:
P951		consists of
	15-84301K04	HOUSING, connector, 6-position
	39-82717M01	CONTACT, receptacle, 5 used
	28-84302N01	PLUG, polarizing key
		impedance network:
Z850, 851	1-80726D09	includes
	6-124D01	RESISTOR, fixed: 10 ± 10%, 1/4 W
	76-84069B01	BEAD, ferrite
		non-referenced items
	4-114522	WASHER, lock, 5/8" int.
	30-83794C01	CABLE, coax, 10.5" used
	32-80086A01	GASKET, antenna connector
	42-83896M01	GASKET, rf
	42-35424B01	STRAP, tie
	42-80013A01	CLIP, coax
	42-80167B01	CLIP, top bus
	42-80201B01	CLIP, buss wire
	42 83674M01	RETAINER bus
	42-83982N01	CLIP, cable
	42-84510M01	STRAP, PA
	76-84069B04	BEAD, ferrite 11 used
	4-83755H01	WASHER, shoulder 6 used
	64-80122B01	PLATE, feedthru

note. For parts not listed in the above parts list refer to the mechanical parts section

TRN8855A PA Metering Board — PL-7030-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1103, 1104	21-83406D64	5.6 pF ± .25 pF, 500 V
		connector, receptacle,
J1101	9-84207B01	female 7 contact
		coil, rf:
L1100, 1101	24-82723H04	choke, 290 nH
		non-referenced items
	28-84528K21	CONNECTOR plug, single contact
	29-84706E06	TERMINAL, crimp socket 4 used

Field repair of this kit is not recommended. It should be replaced in its entirety. The following parts are listed for reference purposes only.

TRN8856A Directional Coupler — PL-7031-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C900-904	21-84873H63	39 pF ± 5%, CHIP
		coil, rf:
L900, 901	24-5318D18	11 turns
L902, 903	24-5318D07	6 turns
L904, 905	24-82723H04	290 nH
		non-referenced items
	7-83481M01	FRAME directional coupler
	29-83208M01	LUG, solder

Field repair of this kit is not recommended. It should be replaced in its entirety. The following parts are listed for reference purposes only.

TRN8851A Intermediate Power Amplifier — PL-7032-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle, assembly:
J700	1-80719D61	phono female includes PLATE IPA
		coil, rf:
L700	24-5318D20	3 turns
L701, 702	24-82723H04	choke, 290 nH
L703	24-5318D20	3 turns
L704	24-82723H04	choke, 290 nH
		capacitor, fixed; ± 5%
		unless otherwise stated
C700, 703, 706, 707, 709, 713	21-84873H63	39 pF, CHIP
C702, 710	21-84873H75	7 pF, CHIP
C704	21-84677D06	1 5 pF, ± 20%, TANTALUM
C705	21-84873H59	100 pF, CHIP
C701	21-84873H77	12 pF, CHIP
C708, 714	21-84547A11	.01, ± 20%, CHIP
C711	21-84873H57	27 pF, CHIP
C712	21-84874A78	10 pF, CHIP
		non-referenced items
	1-80715D05	INTERNAL POWER AMPLIFIER, input (substrate)
	1-80715D07	INTERNAL POWER AMPLIFIER, output (substrate)
	29 828 1 D01	PIN terminal - solder
	30 8336 1G01	CABLE, coax, 50 Ω, 4.5" used
	30 83794E01	CABLE, coax, 2.9", 50 Ω
	30 15151A17	WIRE, #24 copper
	2 7001	NUT, hex, 8-32 x 5/16 x 1/16
	42 35424B01	STRAP, tie

Field repair of this kit is not recommended. It should be replaced in its entirety. The following parts are listed for reference purposes only.

TRN8852A Pre-Driver Module — PL-7033-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		coil, rf:
L750	24-5318D18	11 turns
L751, 752	24-80202B03	choke, 4 turns w/ferrite bead
		capacitor, fixed
C750-C753	21-84736E15	12 pF, ± 5%, CHIP
C756, 759		
C755, 756	21-84873H63	39 pF, ± 10%, CHIP
C757	21-84547A11	.01, ± 20%, CHIP
		non-referenced items
	29-83208M01	LUG, solder, 3 used
	42-80164B01	RETAINER, substrate
	42-80165B01	CLIP, substrate retainer, 2 used

Field repair of this kit is not recommended. It should be replaced in its entirety. The following parts are listed for reference purposes only.

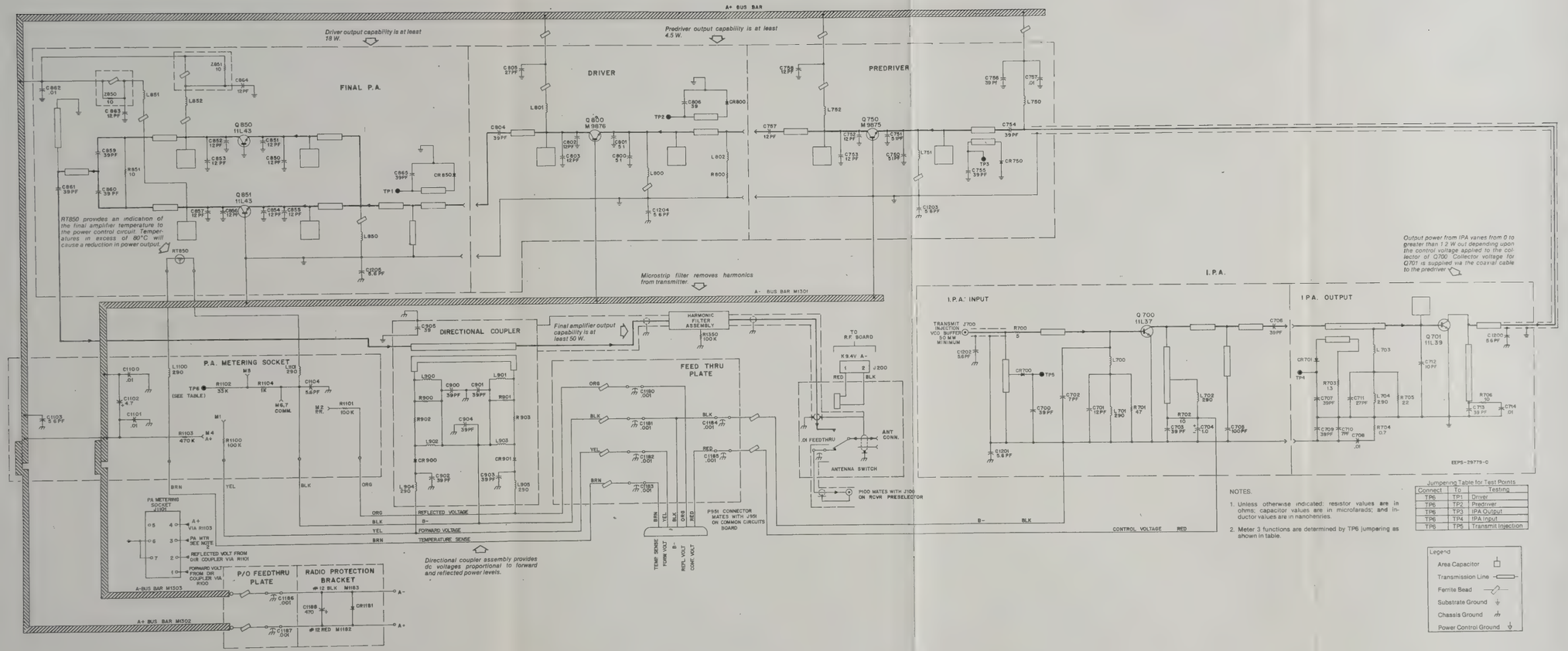
TRN8853A Driver Module — PL-7034-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		coil, rf:
L800, 801	24 80202B03	choke, 4 turns w/ferrite bead
L802	24-80202B02	choke, 4 turns
		capacitor, fixed; ± 5%
		unless otherwise stated
C800-C803	21-84736E15	12 pF, CHIP
C804	21-84736E12	39 pF, CHIP
C805	21-84873H57	27 pF
C806	21-84873H63	39 pF, CHIP
R800	6-185B55	resistor, fixed 10 ± 10%, 1/8 W
		non-referenced items
	29-83208M01	LUG, solder, 2 used
	42-80164B01	RETAINER, substrate
	42-80165B01	CLIP, substrate retainer, 2 used

Field repair of this kit is not recommended. It should be replaced in its entirety. The following parts are listed for reference purposes only.

TRN8854A Final Amplifier — PL-7035-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed
C862	21-84547A11	.01, ± 20%, CHIP
C850-C857	21-84736E15	12 pF, ± 5%, CHIP
C859-C861	21-84736E12	39 pF, ± 5%, CHIP
C863, 864	21-84873H36	12 pF, ± 10%, CHIP
C865	21-84873H63	39 pF, ± 5%, CHIP
		coil, rf
L850, 851, 852	24-80202B01	choke, 1 turn w/ferrite bead
R851	6-124D01	resistor, fixed 10 ± 10%, 1/4 W
		non-referenced items
	4-114522	WASHER, lock, 5/8" int.



Substrates Power Amplifier Deck Schematic Diagram &
*Motorola No. **PEPS-30808-A***
(Sheet 2 of 2)
1/15/81-PHI

COMMON CIRCUITS BOARD (TRN8862A)

1. DESCRIPTION

1.1 The common circuits board (as shown in the schematic diagram PEPS-30809 appended to the end of this section) consists of the following circuits:

- rf power control
- IDC
- regulator.

NOTE

Because of the functions of these circuits, the theory of operation and troubleshooting information associated with each circuit are presented in the following sections of this manual:

- RF Power Control (Transmitter section)
- IDC (Synthesizer section)
- Regulator (Common Circuits Board section)

2. THEORY OF OPERATION — REGULATOR

2.1 INTRODUCTION

The regulator provides the radio with the voltages required. It consists of:

- +9.6 V regulator
- 5.0 V regulator
- reference circuit
- shut-back circuit.

2.2 REFERENCE CIRCUIT

The reference circuit employs a Zener diode (which forms part of HY1001), an operational amplifier (U1001B), and a factory-adjusted resistor network to provide a reference voltage of approximately 7.0 V at its output (U1001B-4). This reference output voltage is used to generate both the 5.0 V and 9.6 V supply voltages.

2.3 9.6 V REGULATOR

The 9.6 V regulator is protected against short circuits. If a short circuit occurs in the regulator, it will forward-bias CR1002, thus causing it to switch on and remove the drive power from output transistor Q1001.

2.4 5.0 V REGULATOR

The 5.0 V regulator is protected against excessively high output current levels. This is achieved by using a foldback current-limiting circuit that senses the voltages across R1002 and R1003. If the output current level reaches a predetermined level, Q1003 switches on, blocking the drive to output transistor Q1002.

2.5 SHUTBACK CIRCUIT

2.5.1 The shutback circuit is designed to turn off both regulators (the 5.0 V and 9.6 V) whenever the supply voltage rises above (or goes below) a predetermined level. If the supply voltage reaches 18 V, VR1005 turns on, causing Q1006 to turn on. Consequently, Q1005 loses its input drive, thus causing the 9.6 V regulator to turn off. Moreover, this will also forward bias CR1003, thus causing the 5.0 V regulator to turn off.

2.5.2 When the supply voltage (SW A+) falls below 9.0 V, U1001A switches states, causing Q1006 to turn on and, consequently, both regulators to turn off. In this case, CR1004 causes the reference voltage to U1001A-1 to change when in the shutback mode. Consequently, both regulators will remain shut off until the supply voltage rises at least 1 volt above the critical level for 9.0 V.

3. REGULATOR TROUBLESHOOTING PROCEDURE

The regulator troubleshooting procedure consists of the following three procedures:

- failure of both the 5.0 V and 9.6 V regulators
- failure of only the 9.6 V regulator
- failure of only the 5.0 V regulator.

3.1 FAILURE OF BOTH REGULATORS

Step 1. Inspect J2 and the main front plug and verify that they are properly inserted.

Step 2. Measure A+ at J2-15 on the common circuits board. The normal indication is 10.5 to 16 V. If the A+ indication is present but outside the normal range, the low or high-line shutdown circuit may have been activated, shutting off the regulators. Adjust A+ to the proper voltage and re-check the regulators outputs. If A+ is not present, check continuity of the A+ and ground lines to isolate the fault.

Step 3. Measure the voltage at the Q1006 collector. A normal indication should be less than 0.6 V. If an incorrect indication is obtained, the shutback circuit should be repaired.

Step 4. Measure the voltage at HY1001-9. An indication of 7 ±0.1 V should be obtained. If an incorrect indication is obtained, the 7 V reference circuit should be repaired.

NOTE

If the above-outlined procedure fails to remedy the problem, then each regulator should be separately repaired.

3.2 FAILURE OF 5 V REGULATOR

Step 1. Check the output of the 9.6 V regulator at J2-11 and verify that an indication of 9.6 ±0.1 V is obtained. If the indication is incorrect, refer to the preceding procedure.

Step 2. With the radio turned off, check the resistance between J2-12 and ground and verify that an indication of greater than 100 ohms is obtained. If the indication is incorrect, make the necessary checks to isolate the fault; the fault may not necessarily be on the common circuit board.

Step 3. With power turned on, measure the voltage difference between U1001-12 and J2-12 and verify that an indication of less than 2.5 V is obtained. If the indication is correct, proceed to Step 5; otherwise go to the following step.

Step 4. Isolate the component with the excessive voltage drop. An excessive drop across R1009 may be caused by;

- excessive Q1002 base current because of a defective transistor or open collector;
- a fault in the 5 V current limiter circuit (Q1003, R1003, R1005, R1016) causing Q1003 to turn on;
- a shorted printed circuit board runner;
- a defective R1009;
- an excessive drop across Q1002 or R1002 is probably due to a fault in the component with the abnormal voltage drop.

Step 5. Measure the voltage at U1001-13 and verify that an indication of 5 ±0.1 V is obtained. If the indication is correct, go to Step 7; otherwise, go to next step.

Step 6. Measure the voltage at HY1001-9 and verify that an indication of 7 ±1 V is obtained. If the proper indication is obtained, replace HY1001 or U1001; if the indication is incorrect, repair the 7 V reference circuit.

Step 7. Measure the voltage difference between U1001-14 and J2-12 and verify that an indication of 0 V is obtained. If the indication is correct, go to the next step; otherwise proceed as follows:

- if CR1003 is forward biased, repair the shutback circuit; otherwise replace R1010 or U1001.

Step 8. Measure the voltage at U1001-12 and determine why the feedback loop does not function properly.

3.3 FAILURE OF 9.6 V REGULATOR

Step 1. Check and verify that the 5 V regulator output voltage at J2-12 is 5.0 V. If the indication is correct, go to the next step; otherwise, refer to the procedure entitled Failure of Both Regulators.

Step 2. Check the 9.6 output voltage at J2-11 and verify that an indication of 9.6 ±0.1 V is obtained. If the indication is too low, go to Step 3; if too high, go to Step 6.

Step 3. With the radio turned off, check the resistance between J2-11 and ground. If a correct indication greater than 30 ohms is obtained, go to the next step; otherwise, make the necessary checks to isolate the fault, which may not necessarily be on the common circuit board.

Step 4. With power turned on, measure the voltage at Q1006 base and verify that an indication greater than 10 V is obtained. If the proper indication is obtained, go to the next step; otherwise, replace HY1001, U1001, or Q1006. A voltage higher than 2.5 V but lower than 10 V indicates that Q1006 may be defective.

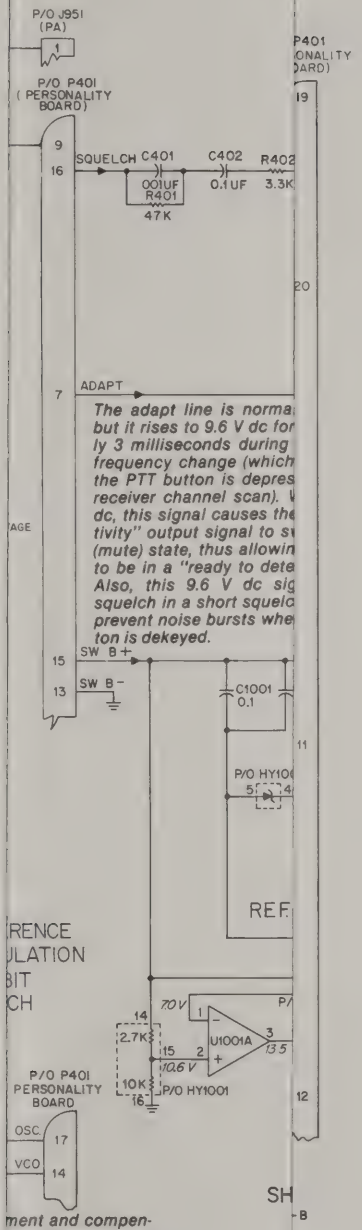
Step 5. Replace Q1001 or repair the circuit board.

Step 6. Measure the voltage at Q1006 base and verify that the voltage is less than 0.5 V. If the indication is correct, replace Q1001 or repair the circuit board; otherwise, replace U1001 or HY1001.

DESCRIPTION
560
variable; 10k
220k
220k
100k
220
100k
180k
100k
22k
1k
220k
1 meg
1k
220k
10k
470
1k
1; 1/2 W
220k
100k
220
3.3k
47k
10k
12k
10k
22k
47k
10k
47k
3.3k
variable, 10k
56k
22k
10k
68k
10k
6.2k
18k
15k
390
6.2k
68k
10k
47k
10k
4.7k
100k
1k
1.8 ± 10%; 1/2 W
270
2.7k
270
62; 1/2 W
560
680
4.7k
22k
270
470k
220k
270
2.7k
thermistor:
195k @ 25 °C
integrated circuit: (see note)
quad op-amp; type M2906
quad analog switch; type M870
quad op-amp; type M2906
quad op-amp; type M2918
quad op-amp; type M2906
voltage regulator:
Zener; 18 V
hybrid, assembly:
resistor network
resistor network
resistor network
regulator hybrid
note
The mechanical parts are l mechanical parts list provi general maintenance secti manual.

, diodes, transistors and integrate
bers.

Common Circuit Board Schematic Diagram, Circuit Board Detail and Parts List Motorola No. ***PEPS-30809-A*** *(Sheet 1 of 2)*
1/15/81-PHI



NOTES:

1. Unless otherwise indicated, resistor values are in ohms; capacitor values in microfarads.
2. Integrated circuits on this board are CMOS devices; consequently, proper care should be taken while handling these devices.
3. Types and connections for the integrated circuits used on this board are as follows:

Reference Designation	Type	Vcc (Pin)	Gnd (Pin)	Mfgr's Description
U401, U502	29M06	11 (+ 9.6 V)	7	Quad op amp
U501	87K04	14 (9.6 V)	7	Quad transmission gate
U901	29M18	4 (K9.4 V)	11	Quad op amp
U1001	29M06	11 (A +)	7	Quad op amp

5. All voltages shown are referenced to A-.
6. All voltages shown on the rf power control are measured under the following conditions:
   (A) 13.6 A + voltage
   (B) 50-ohm radio termination
   (C) 38-watt set output power
7. Voltages accompanied by an asterisk are dependent on the gain of the PA or the coupling of the directional coupler. Typical voltage ranges are provided for these cases.

Metering Indications

Meter #	Function	Normal Indication (Approx.)
1	Forward Voltage (Power Control)	See Transmitter Schematic Diagram (EEPS-29779)
2	Reflected Voltage (Power Control)	See Transmitter Schematic Diagram
3	Control Voltage (Power Control)	13 uA-25 uA
4	Reference Voltage (Regulator)	15 uA

COMMON CIRCUITS BOARD

Common Circuits Board Schematic Diagram, Circuit Board Detail and Parts List
Motorola No. PEPS-30809-A
(Sheet 2 of 2)
1/15/81-PHI

parts list

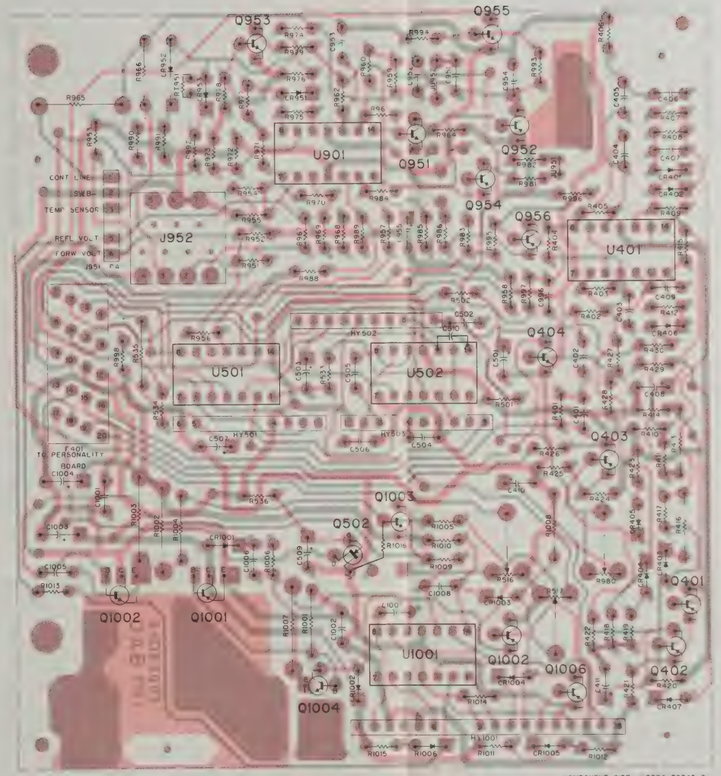
TRN8862A Common Circuit Board — PL-6971-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 50 V: unless otherwise stated
C401	8-11017B01	.001
C402	8-11017B17	0.1
C403	21-11015B05	220 pF; 100 V
C404	21-11014B47	82 pF ± 5%; 100 V
C405	8-11017B08	.01
C406	8-11017A03	.0022 ± 5%
C407	21-11015B05	220 pF; 100 V
C408	23-11013E57	10 ± 20%; 25 V
C409	8-11017B08	.01
C410	23-11013F57	1 ± 20%; 35 V
C411	23-11013F59	2.2 ± 20%; 35 V
C501	23-11013E57	10 ± 20%; 25 V
C502	8-11017A02	.0015 ± 5%
C503	23-11013F57	1 ± 20%; 35 V
C504	8-11017A02	.0015 ± 5%
C505	8-11017A03	.0022 ± 5%
C506	21-11014B47	82 pF ± 5%; 100 V
C507, 508	23-11013E57	10 ± 20%; 25 V
C510	21-82358G11	85 pF ± 5%; 100 V
C951	8-11017B08	.01
C952	8-11017B17	0.1
C953	8-11017A06	.0047 ± 5%
C954, 955	23-11013E57	1 ± 20%; 35 V
C956	8-11017B08	.01
C1001	8-11017B17	0.1
C1002	21-11015B05	220 pF ± 10%; 100 V
C1003, 1004	23-84538G06	47 ± 20%; 20 V
C1005	21-11015B05	220 pF; 100 V
C1006	8-11017B13	.033
C1007	21-11015B05	220 pF; 100 V
C1008	21-11014B47	82 pF ± 5%; 100 V
		diode: (see note)
CR401 thru 407	48-83654H01	silicon
CR95 thru 953	48-83654H01	silicon
CR1001 thru 1004, 1006	48-83654H01	silicon
		connector, receptacle:
J951	28-84647L04	male, 6-contact
J952	9-84207B01	female, 7-contact
P401	30-83602M01	ribbon cable; includes female connector soldered to board and 20 contact male connector
		transistor: (see note)
Q401, 402	48-869642	NPN; type M9642
Q403	48-869643	PNP; type M9643
Q404	48-869642	NPN; type M9642
Q502	48-869660	P-channel FET; type M9660
Q951	48-869642	PNP; type M9642
Q952	48-869641	PNP; type M9641
Q953	48-869642	NPN; type M9642
Q954	48-869643	PNP; type M9643
Q955	48-869706	NPN; type M9706
Q956	48-869643	PNP; type M9643
Q1001	48-84413L05	PNP; type M1305
Q1002	48-84413L10	Darlington, NPN; type M1310
Q1003	48-869642	NPN; type M9642
Q1004	48-869640	NPN; type M9640
Q1005	48-869649	PNP; type M9649
Q1006	48-869643	NPN; type M9643
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R401	6-11009E89	47k
R402	6-11009E61	3.3k
R403	6-11009E85	33k
R404	6-11009E69	6.8k
R405	6-11009E97	100k
R406	6-11009A33	220
R407	6-11009E53	1.5k
R408	6-11009E89	47k
R409	6-11009F06	220k
R410	6-11009E61	3.3k
R411	6-11009E33	220
R412	6-11009E73	10k
R413	6-11009E33	220
R414	6-11009E61	3.3k
R415	6-11009E73	10k
R416	6-11009A69	6.8k
R417, 418	6-11009F02	150k
R419	6-11009E75	12k
R420	6-11009E73	10k
R421	6-11009E45	680
R422	6-11009F06	220k
R423	6-11009F20	820k
R424	6-11009E53	1.5k
R425	6-11009E59	2.7k
R426	6-11009E77	15k
R427	6-11009E69	6.8k
R428	6-11009E49	1k
R429	6-11009E85	33k
R430	6-11009E93	68k
R501	6-11009A49	1k
R502	6-11009A43	560
R516, 517	18-83311K06	variable; 10k
R533	6-11009B06	220k
R534 thru 535	6-11009F06	220k
R951	6-11009E97	100k
R952	6-11009E33	220
R953	6-11009E97	100k
R954	6-11009F04	180k
R955	6-11009E97	100k
R956	6-11009E81	22k
R957	6-11009E49	1k
R958	6-11009F06	220k
R959	6-11009F22	1 meg
R960 -	6-11009E49	1k
R961	6-11009F06	220k
R962	6-11009E73	10k
R963	6-11009E41	470
R964	6-11009E49	1k
R965	6-12SB70	1; 1/2 W
R966	6-11009B06	220k
R967	6-11009E97	100k
R968	6-11009E33	220
R969	6-11009E61	3.3k
R970	6-11009E89	47k
R971	6-11009E73	10k
R972	6-11009E75	12k
R973	6-11009E73	10k
R974	6-11009E81	22k
R975, 976	6-11009E89	47k
R977	6-11009E73	10k
R978	6-11009E89	47k
R979	6-11009E61	3.3k
R980	18-83311K06	variable, 10k
R981	6-11009E91	56k
R982	6-11009E81	22k
R983	6-11009E73	10k
R984, 985	6-11009E93	68k
R986	6-11009E73	10k
R987	6-11009E68	6.2k
R988	6-11009E79	18k
R989	6-11009E77	15k
R990	6-11009E39	390
R991	6-11009E68	6.2k
R992	6-11009E93	68k
R993	6-11009E73	10k
R994	6-11009E89	47k
R995, 996	6-11009E73	10k
R997	6-11009E65	4.7k
R998	6-11009E97	100k
R1001	6-11009E49	1k
R1002, 1003	6-125D72	1.8 ± 10%; 1/2 W
R1004	6-11009A35	270
R1005	6-11009E59	2.7k
R1006	6-11009E35	270
R1007	6-125A20	62; 1/2 W
R1008	6-11009E43	560
R1009	6-11009E45	680
R1010	6-11009E65	4.7k
R1011	6-11009E81	22k
R1112	6-11009E35	270
R1113	6-11009F14	470k
R1014	6-11009F06	220k
R1015	6-11009E35	270
R1018	6-11009E59	2.7k
		thermistor:
RT951	6-867628	195k @ 25°C
		integrated circuit: (see note)
U401	51-83629M06	quad op-amp; type M2906
U501	51-82884L14	quad analog switch; type M8704
U502	51-83629M06	quad op-amp; type M2906
U901	51-83629M18	quad op-amp; type M2918
U1001	51-83629M06	quad op-amp; type M2906
		voltage regulator:
VR1005	48-82256C53	Zener; 18 V
		hybrid, assembly:
HY501	51-82142K12	resistor network
HY502	51-82142K13	resistor network
HY503	51-82142K14	resistor network
HY1001	1-80715D03	regulator hybrid

note

The mechanical parts are listed in the mechanical parts list provided in the general maintenance section of this manual.

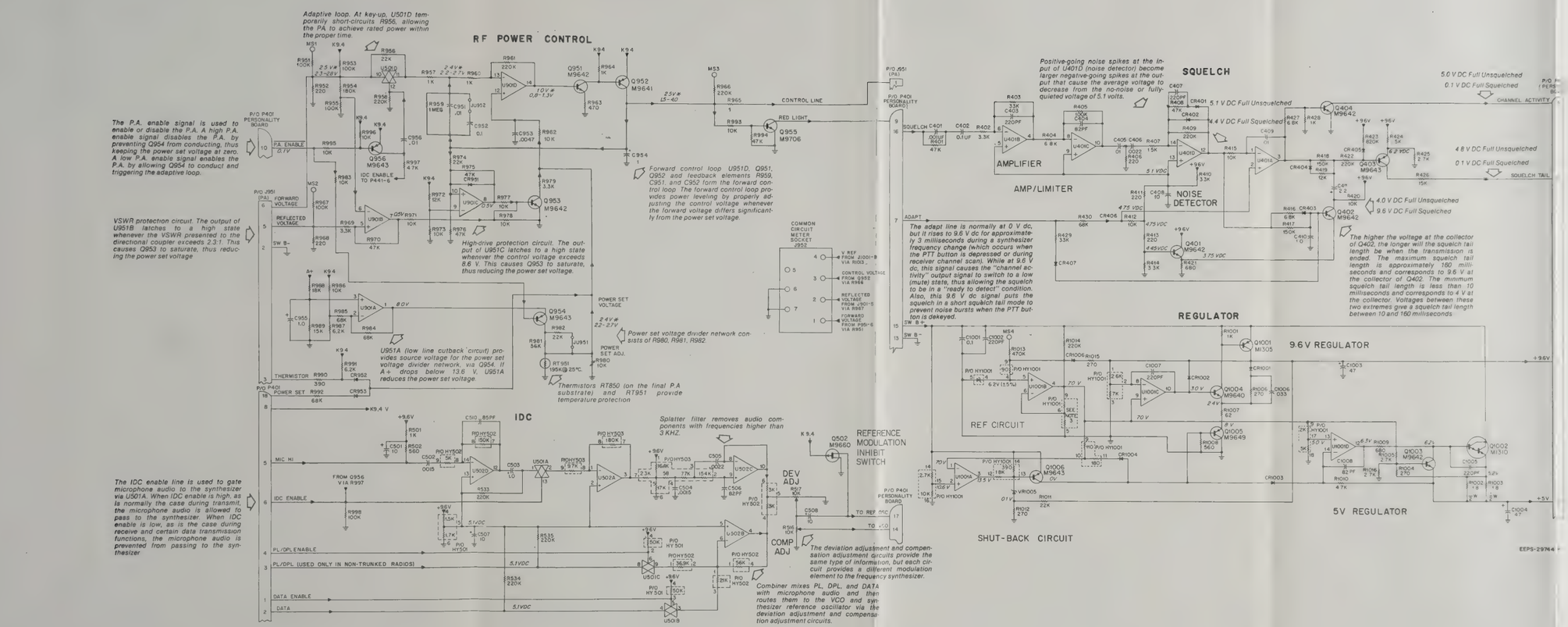
note: For optimum performance, diodes, transistors and integrated circuits must be ordered by Motorola part numbers.



COMPONENT SIDE DEPS-29745-0
SOLDER SIDE DEPS-29746-0
OL DEPS-31460-0

SHOW FROM SOLDER SIDE

Common Circuit Board Schematic Diagram, Circuit Board Detail and Parts List Motorola No. ***PEPS-30809-A*** *(Sheet 1 of 2) 1/15/81-PHI*



NOTES

1. Unless otherwise indicated, resistor values are in ohms; capacitor values in microfarads.
2. Integrated circuits on this board are CMOS devices; consequently, proper care should be taken while handling these devices.
3. Types and connections for the integrated circuits used on this board are as follows:

Reference Designation	Type	Vcc (Pin)	Gnd (Pin)	Mfgr's Description
U401, U502	29M06	11 (+9.6 V)	7	Quad op amp
U501	87KD4	14 (9.6 V)	7	Quad transmission gate
U901	29M18	4 (K9.4 V)	11	Quad op amp
U1001	29M06	11 (A+)	7	Quad op amp

5. All voltages shown are referenced to A-.
6. All voltages shown on the rt power control are measured under the following conditions:
   (A) 13.6 A+ voltage
   (B) 50-ohm radio termination
   (C) 38-watt set output power.
7. Voltages accompanied by an asterisk are dependent on the gain of the PA or the coupling of the directional coupler. Typical voltage ranges are provided for these cases.

Metering Indications

Meter #	Function	Normal Indication (Approx.)
1	Forward Voltage (Power Control)	See Transmitter Schematic Diagram (EEPS-29779)
2	Reflected Voltage (Power Control)	See Transmitter Schematic Diagram
3	Control Voltage (Power Control)	13 uA-25 uA
II	Reference Voltage (Regulator)	15 uA

Common Circuits Board Schematic Diagram, Circuit Board Detail and Parts List
*Motorola No. **PEPS-30809-A***
(Sheet 2 of 2)
1/15/81-PHI

COMMON CIRCUITS BOARD

Common Circuit Board Schematic Diagram,
Circuit Board Detail and Parts List
Motorola No. ***PEPS-30809-A***
(Sheet 1 of 2)
1/15/81-PHI

TRUNKED SYNTOR X CONTROL BOARD

1. INTRODUCTION

The trunked control board accepts data in parallel form from the code plug and the various switches and converts the data into serial form before forwarding it to the radio logic circuitry. Likewise, serial data from the radio logic circuitry is received by the trunked control board and converted into parallel data for display on the indicator lights. Transmission of serial data to the radio is achieved by means of a "polled" protocol in which the radio requests the trunked control board for data, and the control board responds by forwarding the appropriate information. The trunked control board includes: (a) a UART (Universal Asynchronous Receiver/Transmitter), (b) a code plug, (c) a serial data link receiver and transmitter, (d) a +5-volt regulator, (e) a watchdog timer, and, (f) switch interfaces. Refer to the Trunked SYNTOR X Control Board schematic diagram located at the end of this section.

2. UART OPERATION AND TRANSPOND TIMING

The basic function of the UART (U1101) is to act as a parallel-to-serial and serial-to-parallel converter for data sent or received over the serial link to the radio. Eight bits of the receive data (source address) plus one start and one stop bit are received by the UART on the serial receive port, U1101-20. The UART then generates a receive data strobe (RDA on U1101-19) to signal to the external logic circuitry that a data byte has been received. At the same time, the eight source address bits are presented in parallel at the UART parallel outputs (RD7 through RD0 at U1101-5 through U1101-12, respectively) to the code plug (U1103), command decoders (U1102A and 1102B), and the power/busy lamp latch (U1107A). The receive data strobe is then routed to the D input of transfer control latch U1107B so that its $\overline{Q}$ output goes low on the next clock pulse. This $\overline{Q}$ output is applied to the reset data available input of the UART ($\overline{RDAR}$ at U1101-18) to remove the RDA signal from the transpond flip-flop input. The $\overline{RDAR}$ input also signals the UART that the data word has been received by the external logic circuitry. If $\overline{RDAR}$ is not applied to the UART when the next serial word is received, the overrun error flag (OE at U1101-15) will be set causing the UART to reset itself.

U1109C ANDs the RDAR signal (U1109C-9) with the RD6 signal (U1109C-8) and generates a transmit data strobe (TDS at U1109C-10) to the UART. If RD6 is high (indicating a command to set an indicator lamp), a TDS pulse will not be generated; hence no response to the received command will be sent. If RD6 is low, then when RDAR goes low a TDS pulse is generated; this will cause any data present on the return data bus (U1101-26 through U1101-37) during the strobe to be latched into the UART, converted into serial form, and forwarded to the radio via the serial link. In this way, the code plug contents and the various switch states are read.

The receive and transmit clocks (RXCLK and TXCLK at U1101-17 and U1101-40, respectively) determine the speed of transmission of data via the serial link. Since a clock of 16 times the baud rate of the serial link is needed, a frequency of 78.6 kHz (16 x 4800) is required.

The RESET line (U1101-21) initializes the UART upon power up and upon detecting a received data error.

NSB, POE, and NPB (U1101-36, U1101-39, and U1101-35, respectively) represent the control signals to the UART. A low NSB (number of stop bits) causes the selection of one stop bit. POE (odd/even parity) operates in conjunction with NPB (no parity bit). If odd parity is to be selected, both POE and NPB are low. If even parity is to be selected, POE is high, while NPB is low. If NPB is high, no parity bit will be sent. In this case, it is immaterial whether POE is high or low.

NDB1 and NDB2 (number of data bits at U1101-38 and U1101-37, respectively) determine the number of data bits that are sent following the start bit. If NDB1 and NDB2 are high, eight data bits will be selected.

A high CS (control strobe at U1101-34) causes the states of the control lines (NSB, POE, NPB, NDB1, NDB2) to be entered into the UART control register. A low RDE (receive data enable at U11014-4) enables the UART receive data outputs (RD0 through RD7). A low SWE (status word enable at U1101-16) enables the UART status register outputs (FE, OE, RDA, TBE, respectively at U1101-14, U1101-15, U1101-19, and, UU1101-22).

3. COMMAND DECODERS U1102A & U1102B

U1102A decodes the most significant three bits (RD7, RD6, RD5) of the received serial command word according to the following table:

RD7	RD6	RD5	Action
1	X	X	No action taken
0	0	0	Read code plug
0	0	1	Read switches
0	1	0	Write lamps
0	1	1	Write lamps

A high RD7 denotes an invalid word; hence no action is taken when RD7 = 1. The letter X denotes a don't care condition.

Command code 001 (the read switches state) is further decoded into subcommands by U1102B, which examines bits RD3 and RD4 of the received data, in accordance with the following table:

RD7	RD6	RD5	RD4	RD3	Action
0	0	1	0	0	Read switches — lower board
0	0	1	0	1	Read switches — upper board
0	0	1	1	0	Spare
0	0	1	1	1	Spare

4. SWITCH BUFFERS U1105 & U1106

The read switches output at U1102B-12 is applied to the three-state control inputs of switch buffers U1105 and U1106 to gate the switch status of the control head onto the return data bus. When the signal at U1102B-12 goes low, the status of the switches is gated onto the bus. The following format is employed:

D0	Subfleet select line 1 (SF1)
D1	Subfleet select line 2 (SF2)
D2	Subfleet select line 3 (SF3)
D3	Subfleet select line 4 (SF4)
D4	Volume set
D5	Option bit
D6	Reserved
D7	PTT

5. CODE PLUG U1103

The read code plug output at U1102A-4 is applied to U1105E-12 and U1105F-14 for drive amplification; it is then applied to the chip select input of the code plug ($\overline{CS}$ at U1103-15) and to the base of Q1103. When the base of Q1103 is driven low (i.e., the code plug is enabled), Q1103 turns on and power is to the code plug. When the chip enable input at U1103-15 goes low, the three-state buffers are enabled and the code plug contents of the currently addressed memory location are put on the return data bus of the UART. The particular memory address is determined by the source address bus, RD0 to RD4. The memory address can be changed by sending a new code plug command to read a different memory location.

6. BUSY LAMP LATCH & DRIVER

U1107A is a D flip-flop that stores the state of the busy light. When bits RD7, RD6, and RD5 of the received command word are 011, the signal at U1102A-7 goes low indicating the receipt of a write lamp command. This signal (at U1109D-13) is ANDed with $\overline{RDAR}$ (at U1109D-12) to strobe the state of RD3 into the busy lamp latch (U1107A-3). If RD3 is high U1107A-5 is held high causing U1107A-1 to remain high and provide a continuous base drive to Q1102. With full base drive, Q1102 turns on to light the busy lamp at full brilliance.

7. SERIAL LINK COMMUNICATIONS

The serial link to the radio logic circuitry is a five-wire bus consisting of the following:

- Receive Data Bus — This is differentially balanced driven pair of wires that carry data from the radio to the control board.
- Transmit Data Bus — This is a differentially balanced driven pair of wires that carry data from the control board to the radio.
- Clock — This is a shielded wire referenced to ground that carries the synchronizing clock between the serial port on the microprocessor in the radio and the UART in the control board.

The receive data wires are connected to the inverting and non-inverting inputs of the comparator (U1110A-10 and U1110A-11). This comparator refreshes the differential balanced data on the receive link and converts it to an unbalanced signal of proper amplitude to drive the UART (RXDATA at U1101-20). R1103 is connected between U1110A-13 and U1110A-11 for hysteresis purposes to prevent the comparator from oscillating during slow-input transitions.

Transmit data (TXDATA) is generated at U1101-25 and buffered by U1108D. It is then converted into a balanced differential signal by buffers U1108A, U1108B, and U1108C. The signal from U1108D-2 is split into two paths. The first path, going to yellow connector pin 1 (serial data from control board +), has just one inverter to drive the line. The second path, going to yellow connector pin 3 (serial data from control board —), has two inverters to drive the line. Because of the extra inversion in the second path, the two output signals will always be 180° out of phase with each other and, thus, can be used to drive the serial transmit line.

The function of the U1110B is to regenerate the data clock pulse and render it useful to the UART. This is required, since the data clock, after passing through the intercabling, can develop poor rise and fall time characteristics and include a good deal of noise. The received clock pulse is applied to U1110B-8 and is compared with a voltage reference connected to the non-inverting input (U1110B-9). R1112, R1150, and R1148 determine the voltage reference. When the comparator provides a low output (U1110B-14), the voltage on the positive input (U1110B-9) is determined by R1112 and R1150 connected in parallel with R1148. When the comparator provides a high output, the voltage at U1110B-9 (the positive input) is determined by R1148 and R1150 connected in parallel with R1112.

8. SERIAL LINK PROTOCOL

Aside from microphone and receiver audio, all other signaling information is digitized and sent between the radio and control board via a serial data link. Such information consists of 32 bytes of code plug information, SUBFLEET SELECT and VOL/SET switch status, PTT status, and busy light information. The serialization of this data allows for direct communication with the microprocessor in the radio, a smaller control cable with fewer wires and vastly increased expansion capabilities with regard to control panel switch settings and indicators. Because the Trunked SYNTOR X radio is unique with respect to this serial link, the protocol of this link deserves an explanation.

The serial link protocol is a "polled" protocol in that the microprocessor in the radio "asks" the control board for a particular byte of information. The control board then responds with the information. The control board cannot initiate any action on the serial link itself and as such is a slave to the microprocessor. For every poll to the control board there should be a response back to the radio except when sending data to light the busy lamp. There are three basic polls.

- Read code plug (000XXXXX; X = don't care) (D7 … D0)

The control board decodes the upper three bits of this poll into a chip select to the code plug. The lower five bits are presented to the code plug as the five address lines required to address all 32 bytes. Upon power up, all 32 bytes of the code plug are read in rapid succession to be stored in RAM memory in the microprocessor. From there on, the code plug is read one byte at a time every 24 ms taking 768 ms to read the entire code plug to refresh the RAM memory.

- Read switches (00100000) (D7 … D0)

The control board decodes the upper three bits of this poll into a chip select for the switch buffers. The states of the SUBFLEET SELECT, VOL/SET and PTT switches are sent to the radio in the following manner.

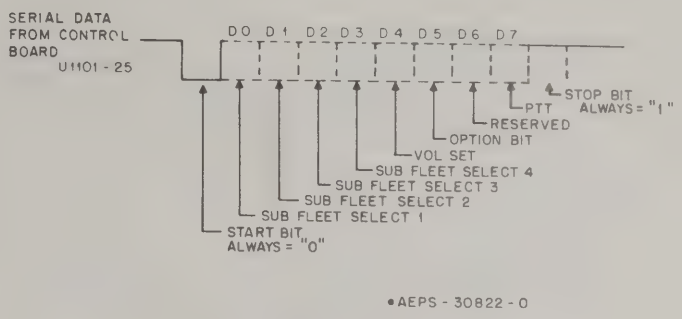


Figure 1.

A "low" in any bit position indicates that the bit is active. A "high" in any bit position indicates an inactive bit.

Note that PTT is no longer a separate wire into the radio but has become a digitized bit.

The option bit being low indicates a request for service from any of the options that are not contained on the control board itself. When the microprocessor detects this bit as being low, it will send out other polls to try to identify the reason for the low bit. These polls are not yet defined.

- Busy light (0110X000 X = 1; Busy light on, X = 0; Busy light off) (D7 … D0)

The upper three bits of this poll are decoded to indicate an operation on the busy light and as such no response to the radio is required. Bit D3 indicates the state of the busy light, a "one" indicating on, a "zero" indicating off.

Refer to Figure 3 for a diagram of these polls.

Figure 2 details the timing of these polls.

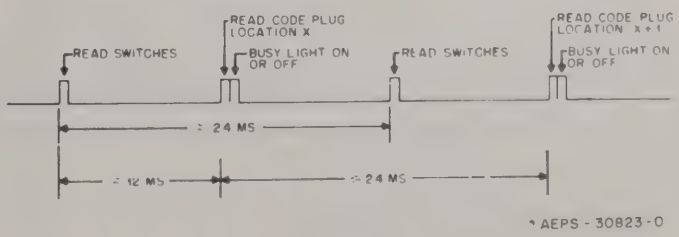


Figure 2.

A "read switches" poll occurs every 24 ms and is intermixed with a "read code plug" poll and refresh busy light command.

The data is transferred in an asynchronous format with one start bit, eight data bits and one stop bit. No parity bit is sent. The nominal data transfer rate is 4800 baud with each bit being approximately 208 ms long.

The data transfer both to and from the radio occurs on a balanced wire pair whose specifications are based on EIA Standard RS422.

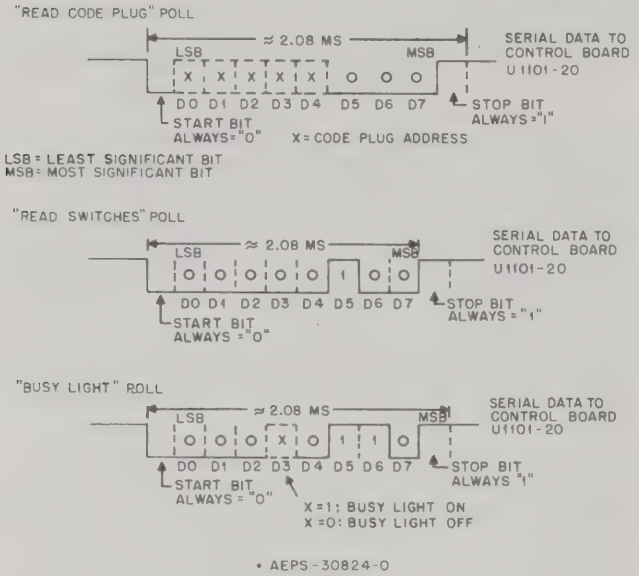


Figure 3.

9. WATCHDOG TIMER U1110C

The watchdog timer is a resettable astable multivibrator whose output is connected to the RESET input (U1101-21) of the UART. The timer's input is connected to the RDA output (U1101-19) of the UART so that each time a command word is received from the radio logic circuitry, a pulse is forwarded to the timer, resetting the time-out. RDA must be present at least once each 50 milliseconds to ensure that the timer does not time-out and reset the UART. If activity from the radio ceases, indicating a possible failure, the watchdog timer times out and resets the UART. Reset pulses will be continually applied to the UART until activity is once again detected on the receive data line.

The astable multivibrator consists of U1110C, R1110, R1111, R1113, R1114, R1115, and C1106. When the output of U1110C is high, C1106 starts to charge through R1110. When the voltage on C1106 becomes equal to the voltage on the non-inverting (+) input of U1110C, the output (U1110C-1) switches to a low state, resulting in two types of action: first, C1106 starts to discharge through R1110 and, second, the voltage at U1110-7 (+ input) switches to a lower voltage (V_{THL}) as result of R1115 being placed in parallel with R1114. The resultant voltage divider network (comprising R1113 in series with the parallel combination of R1114 and R1115) results in a lower voltage at U1110C-7 than would be the case had the comparator's output been high.

When C1106 discharges to the lower voltage level V_{THL}, U1110C once again changes states, causing C1106 to start charging again and a higher voltage (V_{THU}) to be applied to the non-inverting (+) input of U1110C. This higher voltage level is the result of placing R1113 in parallel with R1115. These two resistors (R1113 and R1115) along with R1114 form a voltage divider that is different from the one that was formed when the comparator output was low. In the absence of RDA pulses, the output of U1110C will continue to oscillate between V_{CC} and zero. The potential on C1106 will be a ramp voltage changing from V_{THU} (upper threshold voltage) and V_{THL} (lower threshold voltage) established on U1110-7.

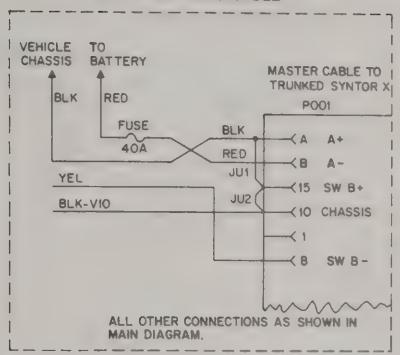
When RDA pulses are present, CR1103 conducts, thus serving to prevent C1106 from charging by providing a discharge path to ground through itself (i.e., CR1103). When a RDA pulse is applied to the SCR (CR1103), the SCR turns on and causes C1106 to discharge to within 1.4 volts to ground (this is the forward "on" voltage of the SCR). CR1103 stays in the conduction state until the discharge current drops below the minimum holding current of the SCR. Subsequently, CR1103 turns off and C1106 starts charging again. If other RDA pulses are applied before C1106 charges to the voltage at U1110C-7, C1106 keeps on discharging repetitively, thus maintaining its voltage lower than that at U1110C-7.

If the RDA pulses stop, C1106 starts charging to the upper voltage threshold level (V_{THU}) and the U1110C output switches to a low state to initiate astable operation of the multivibrator. The generated pulse train is applied to the RESET input of the UART (U1101-21) and the transfer control latch via U1108E and U1109B to maintain the devices in a known state, awaiting the resumption of RDA pulses.

10. TROUBLESHOOTING PROCEDURE

The trunked control board troubleshooting procedure is included in the General Maintenance/ Troubleshooting section of this manual.

ALTERNATE CONNECTIONS FOR
POSITIVE GROUND CABLE



DETAIL A

CABLE CONVERSION PROCEDURE

A NEGATIVE-GROUND CABLE CAN BE CONVERTED INTO POSITIVE GROUND CABLE AS FOLLOWS

CAUTION

MAKE SURE THAT THE CABLE IS DISCONNECTED FROM THE BATTERY

NOTE

USE REMOVAL TOOL (PT# 66B84690C01) FOR REMOVING CABLES.

STEP 1. REMOVE THE LARGE BLACK CABLE FROM PIN B (A-)

STEP 2. REMOVE THE LARGE RED CABLE FROM PIN A (A+)

STEP 3. RECONNECT THE LARGE BLACK CABLE TO PIN A AND THE LARGE RED CABLE TO PIN B

STEP 4. REMOVE BLACK JUMPER JU2 FROM PIN 8 (SW B-), LEAVING JUMPER JU1 UNDISTURBED

STEP 5. REMOVE PIN 8 WITH JU1 AND JU2 ATTACHED

STEP 6. RECONNECT JU1 AND JU2 TO PIN 15 (SW B+).

NOTE

A POSITIVE-GROUND CABLE CAN BE CONVERTED INTO NEGATIVE-GROUND CABLE BY REVERSING THE ABOVE-OUTLINED PROCEDURE.

TRUNKED CONTROL CABLE MODEL CHART

MODEL	LENGTH (FEET)	GROUND POLARITY
TKN8079A	10	NEG
TKN8080A	10	POS
TKN8081A	17	NEG
TKN8083A	17	POS
TKN8082A	22	NEG
TKN8084A	22	POS

CONTROL BOARD

Trunked Mobile Control Cable Wiring Diagram
Motorola No. CEPS-29776-O
7/30/80-PHI

A "read switches" poll occurs every 24 ms and is intermixed with a "read code plug" poll and refresh busy light command.

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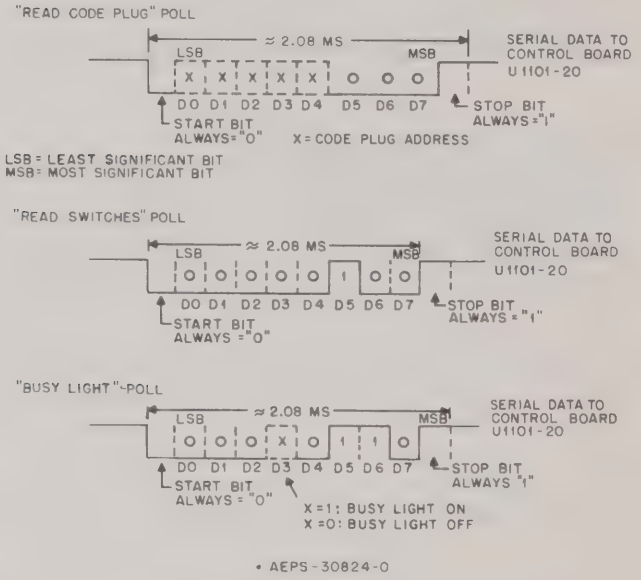

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When C1106 discharges to the lower voltage level V_{THL}, U1110C once again changes states, causing C1106 to start charging again and a higher voltage (V_{THU}) to be applied to the non-inverting (+) input of U1110C. This higher voltage level is the result of placing R1113 in parallel with R1115. These two resistors (R1113 and R1115) along with R1114 form a voltage divider that is different from the one that was formed when the comparator output was low. In the absence of RDA pulses, the output of U1110C will continue to oscillate between V_{CC} and zero. The potential on C1106 will be a ramp voltage changing from V_{THU} (upper threshold voltage) and V_{THL} (lower threshold voltage) established on U1110-7.

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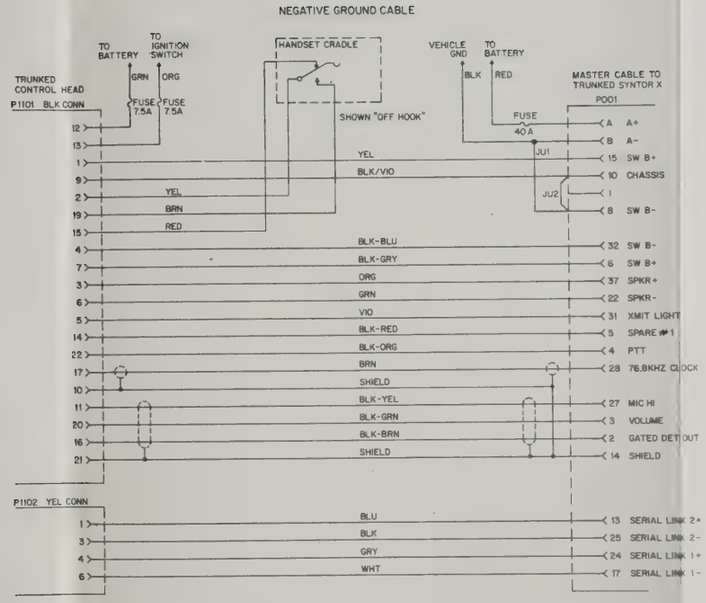
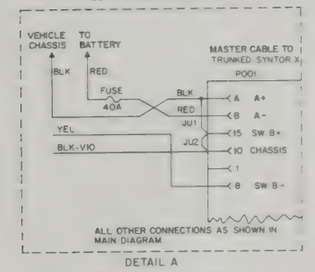
NEGATIVE GROUND CABLE



● DEPS-29776-O

ALTERNATE CONNECTIONS FOR POSITIVE GROUND CABLE



DETAIL A

CABLE CONVERSION PROCEDURE

A NEGATIVE-GROUND CABLE CAN BE CONVERTED INTO POSITIVE GROUND CABLE AS FOLLOWS

CAUTION

MAKE SURE THAT THE CABLE IS DISCONNECTED FROM THE BATTERY

NOTE

USE REMOVAL TOOL (PT# 66B84690C01) FOR REMOVING CABLES

STEP 1. REMOVE THE LARGE BLACK CABLE FROM PIN B (A-)

STEP 2. REMOVE THE LARGE RED CABLE FROM PIN A (A+)

STEP 3. RECONNECT THE LARGE BLACK CABLE TO PIN A AND THE LARGE RED CABLE TO PIN B

STEP 4. REMOVE BLACK JUMPER JU2 FROM PIN 8 (SW B-), LEAVING JUMPER JU1 UNDISTURBED

STEP 5. REMOVE PIN 8 WITH JU1 AND JU2 ATTACHED

STEP 6. RECONNECT JU1 AND JU2 TO PIN 15 (SW B+)

NOTE

A POSITIVE-GROUND CABLE CAN BE CONVERTED IN TO NEGATIVE-GROUND CABLE BY REVERSING THE ABOVE-OUTLINED PROCEDURE

TRUNKED CONTROL CABLE MODEL CHART

MODEL	LENGTH (FEET)	GROUND POLARITY
TKN8079A	10	NEG
TKN8080A	10	POS
TKN8081A	17	NEG
TKN8083A	17	POS
TKN8082A	22	NEG
TKN8084A	22	POS

Trunked Mobile Control Cable Wiring Diagram
Motorola No. CEPS-29776-O
7/30/80-PHI

parts list

TRN4268A Control Head (Basic)
TRN4269A Control Head (w/Volume Set Switch)
TRN4270A Control Head (w/Subfleet Select Switches)
TRN4271A Control (w/Volume Set Switch & Subfleet Select Switches) PL-7025-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 25 V unless otherwise stated
C1103	23-83210A08	100 + 150-10%
C1104, 1105	21-82372C01	0.1 + 80-20%
C1106	23-11013D01	1; 20 V
C1107, 1109	21-11015B13	.001; 100 V
		diode: (see note)
CR1101	48-84621E08	bridge rectifier
CR1103	48-869577	silicon controlled rectifier
CR1104	48-82466H13	silicon
		lamp, assembly:
DS1101 thru 1104	65-84047E01	10 V (TRN4270A & TRN4271A)
DS1105 thru 1107	65-84047E01	10 V
		transistor: (see note)
Q1101	51-84561L76	5 V regulator
Q1102	48-869706	NPN; type M9706
Q1103	48-869649	PNP; type M9649
		resistor, fixed: ± 5%; 1/4 W unless otherwise stated
R1101, 1102	6-11009E73	10k
R1103	6-11009E97	100k
R1104	6-11009E49	1k
R1105, 1106	6-11009E57	2.2k
R1107	6-125A09	22; 1/2 W
R1109	6-11009E73	10k
R1110	6-11009F05	200k
R1111	6-11009E65	4.7k
R1112	6-11009E85	33k
R1113	6-11009E77	15k
R1114, 1115	6-11009E84	30k
R1116	6-11009E57	2.2k
R1117	6-11009E51	1.2k
R1118	6-11009E57	2.2k
R1119	6-127C43	560 ± 10%; 2 W
R1120	6-125A29	150; 1/2 W
R1121 thru 1124	6-126A19	56; 1 W (TRN4270A & TRN4271A)
R1125	6-126A19	56; 1 W
R1126 thru 1129	6-125A29	150; 1/2 W (TRN4270A & TRN4271A)
R1130	6-125A29	150; 1/2 W
R1131	6-11009E49	1k
R1132	6-11009E73	10k
R1133, 1134	6-11009E84	30k
R1135	6-11009E73	10k
R1136, 1137	51-82142K06	resistor network
R1138	6-11009E81	22k
R1144	6-11009E39	390
R1145	6-11009E32	200
R1146	18-82238D23	variable; 25k
R1147	6-124A49	1k
R1148	6-11009F02	150k
R1149	6-11009E75	12k
R1150	6-11009E77	15k
R1151, 1152	6-126A19	56; 1 W
R1154	6-11009E81	22k
		switch assembly:
S1101	—	includes:
	40-84635C03	SWITCH, slide: dpdt, momentary
	1-80721D05	SWITCH ASSEMBLY, includes:
	40-84324C40	SWITCH, pushbutton: 1-section, w/lockout
	14-84360C01	INSULATOR, switch
S1102	1-80721D06	includes: (TRN4270A & TRN4271A)
	40-84324C06	SWITCH, pushbutton: 5-section
	14-84360C01	INSULATOR, switch; 5 used
S1103	1-80721D07	includes: (TRN4269A & TRN4271A)
	40-84324C01	SWITCH, pushbutton: 1-section
	14-84360C01	INSULATOR, switch
		integrated circuit: (see note)
U1101	51-82848M68	UART
U1102	51-82884L69	dual binary to 1-of-4 decoder
U1103	51-82848M48	PROM
U1105, 1106	51-84561L96	tristate buffer
U1107	51-82884L13	dual D flip-flop
U1108	51-84561L03	hex inverter
U1109	51-84371K94	quad OR gate
U1110	51-84371K74	quad comparator
U1111	51-84371K82	opto-isolator
		non-referenced items
	9-84924E02	SOCKET, IC: 16-contact
	2-10101A68	NUT, spring
	36-84900C02	KNOB, potentiometer
	1-80721D04	CIRCUIT BOARD ASSEMBLY includes:
	28-84269C01	CONTACT, male: low profile; 17 used
	28-84269C02	CONTACT, male; high profile; 15 used
	84-83451M01	PC BOARD, control head

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

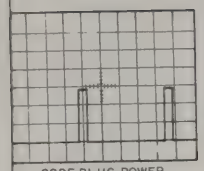
* S1102E IS LABELED [E] ON FIVE SUBFLEET MODELS ONLY. OTHERWISE S1102E IS LABELED [ON]

** THE [BUSY] LIGHT APPEARS ON ALL MODELS

*** WIRE IS PART OF HANDSET HANGUP BOX KIT

**** WIRE IS PART OF BATTERY CABLE KIT

PONENT SIDE DEPS-29392-O
SOLDER SIDE DEPS-29393-O
OL DEPS-29394-A



CODE PLUG POWER
U1103-16, 5 MS/DIV., 2 VOLT/DIV.

resistor values are in
in microfarads; and in-
s.

gic.

105, U1106, U1107, and
devices.

enclosed in dotted lines
270A and TRN4271A.

n Kits TRN4269A and

s board are as follows:

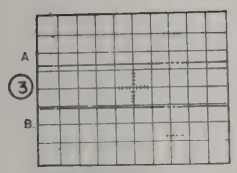
VCC (+5 V)	Gnd	Mfgr's Description
1	3	UART
16	8	Dual Binary to 1-of-4 Decoder
	8	PROM
16	8	Tristate Buffer
14	7	Dual D Flip-Flop
14	7	Hex Inverter
14	7	Quad OR Gate
12 V)	12	Quad Comparator
		Opto-Isolator

only if control head is
TOR X Radio with Cable

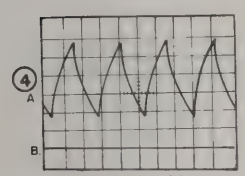
Function
ndset Audio. Switched
landset Audio. Switched
dset Audio. Continuous
ndset Audio. Continuous

ut Logic Levels

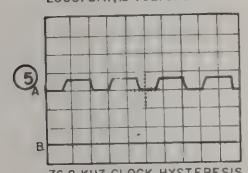
Minimum Logic "1"	Maximum Logic "0"
2.4 V	0.4 V
4.7 V	.05 V
2.4 V	0.4 V
4.7 V	.05 V
4.7 V	.05 V
2.5 V	0.4 V
4.7 V	.05 V



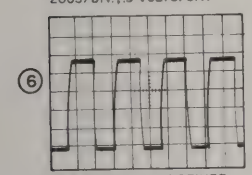
TRANSMIT DATA
A. U1108-6
B. U1108-12
2MS/DIV. 2VOLTS/DIV.
(EXACT BIT PATTERN MAY VARY DEPENDING ON SERIAL WORD)



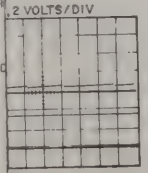
76.8 KHZ CLOCK
A. U1110-8
B. GROUND
20US/DIV., .5 VOLTS/DIV.



76.8 KHZ CLOCK HYSTERESIS
A. U1110-9
B. GROUND
20US/DIV., .5 VOLTS/DIV.



76.8 KHZ CLOCK RECEIVED AT U1101-17 AND U1101-40
20 US/DIV, 1 VOLT/DIV.



2 VOLTS/DIV

TRUTH TABLE FOR U1102
X=DON'T CARE

G	A	B	YO	Y1	Y2	Y3
0	0	0	0	1	1	1
0	1	0	1	0	1	1
0	0	1	1	1	0	1
0	1	1	1	1	1	0
1	X	X	1	1	1	1

CODE PLUG SELECT TO J1106-13

SERIAL DATA TO CONTROL BOARD

SERIAL DATA FROM CONTROL BOARD

U1105E

U1105F

C1107
.001UF
R1118
2.2K

P/O HANDSET HANG-UP BOX (OPTIONAL)

SWITCH BANK SELECT

(SHOWN OFF HOOK)

R1122 56
R1123 56
R1124 56
R1127 150
R1128 150
R1129 150

DS1103

DS1104

SERVI

TO SPEAKER

HANDSET

MIC

TO MIC OR HANDSET

IGNITION

BAT

SW BA

C1109
.001

R1116
2.2K

R1132
10K

SIP RESISTOR NETWORK R1136

+5V (V1)

22K

MS PRESENT

GATED DET RMAL OPERATING NS

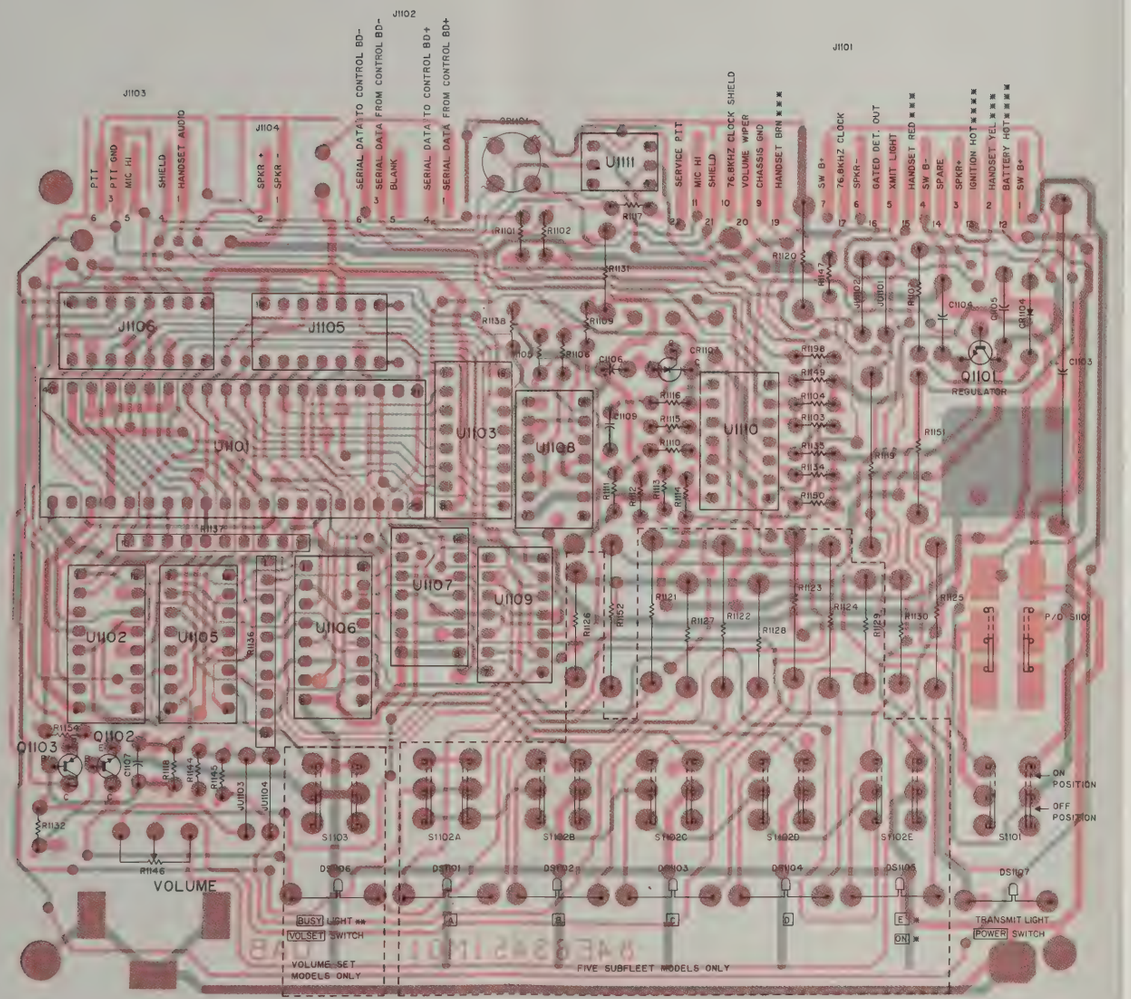
VOLUME (REC A

VOLUME SH

TRANSMIT IND

VOLUME SE SWITCH

Trunked Mobile Control Head
Schematic Diagram
Motorola No. EEPS-29391-A
10/30/80-PHI



SHOWN FROM COMPONENT SIDE

* S1102E IS LABELED E ON FIVE SUBFLEET MODELS ONLY. OTHERWISE S1102E IS LABELED ON

** THE BUSY LIGHT APPEARS ON ALL MODELS

*** WIRE IS PART OF HANDSET HANGUP BOX KIT

**** WIRE IS PART OF BATTERY CABLE KIT

COMPONENT SIDE = DEPS-29392-O
SOLDER SIDE DEPS-29393-O
OL DEPS-29394-A

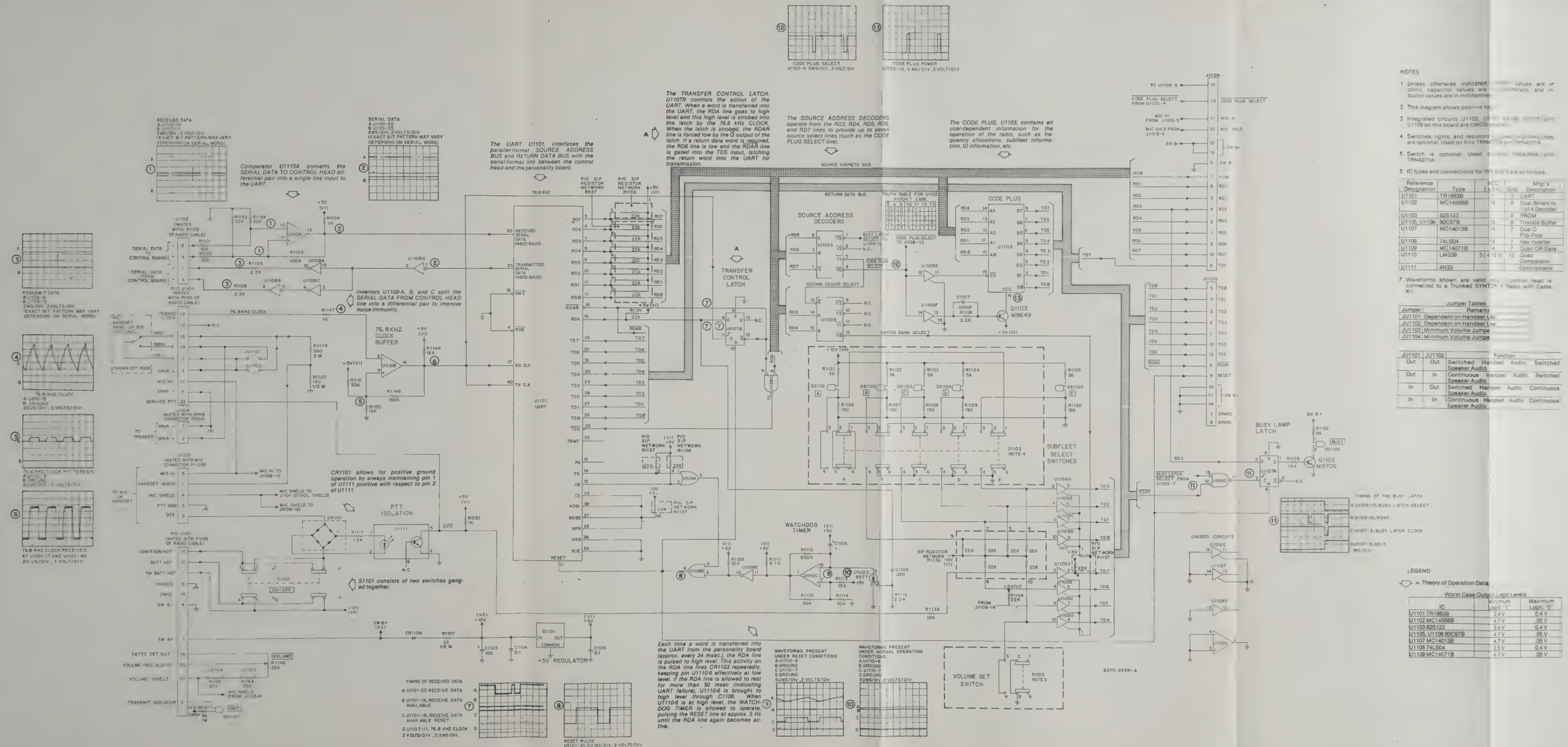
Trunked Mobile Control Head
Circuit Board Detail and Parts List
*Motorola No. **PEPS-29395-B***
1/15/81-PHI

parts list

TRN4268A Control Head (Basic)
TRN4269A Control Head (w/Volume Set Switch)
TRN4270A Control Head (w/Subfleet Select Switches)
TRN4271A Control (w/Volume Set Switch & Subfleet Select Switches) PL-7025-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 10%; 25 V unless otherwise stated
C1103	23-83210A08	100 + 150-10%
C1104, 1105	21-82372C01	0.1 + 80-20%
C1106	23-11013D01	1; 20 V
C1107, 1109	21-11015B13	.001; 100 V
		diode: (see note)
CR1101	48-84621E08	bridge rectifier
CR1103	48-869577	silicon controlled rectifier
CR1104	48-82466H13	silicon
		lamp, assembly:
DS1101 thru 1104	65-84047E01	10 V (TRN4270A & TRN4271A)
DS1105 thru 1107	65-84047E01	10 V
		transistor: (see note)
Q1101	51-84561L76	5 V regulator
Q1102	48-869706	NPN; type M9706
Q1103	48-869649	PNP; type M9649
		resistor, fixed: ± 5%; 1/4 W unless otherwise stated
R1101, 1102	6-11009E73	10k
R1103	6-11009E97	100k
R1104	6-11009E49	1k
R1105, 1106	6-11009E57	2.2k
R1107	6-125A09	22; 1/2 W
R1109	6-11009E73	10k
R1110	6-11009F05	200k
R1111	6-11009E65	4.7k
R1112	6-11009E85	33k
R1113	6-11009E77	15k
R1114, 1115	6-11009E84	30k
R1116	6-11009E57	2.2k
R1117	6-11009E51	1.2k
R1118	6-11009E57	2.2k
R1119	6-127C43	560 ± 10%; 2 W
R1120	6-125A29	150; 1/2 W
R1121 thru 1124	6-126A19	56; 1 W (TRN4270A & TRN4271A)
R1125	6-126A19	56; 1 W
R1126 thru 1129	6-125A29	150; 1/2 W (TRN4270A & TRN4271A)
R1130	6-125A29	150; 1/2 W
R1131	6-11009E49	1k
R1132	6-11009E73	10k
R1133, 1134	6-11009E84	30k
R1135	6-11009E73	10k
R1136, 1137	51-82142K06	resistor network
R1138	6-11009E81	22k
R1144	6-11009E39	390
R1145	6-11009E32	200
R1146	18-82238D23	variable; 25k
R1147	6-124A49	1k
R1148	6-11009F02	150k
R1149	6-11009E75	12k
R1150	6-11009E77	15k
R1151, 1152	6-126A19	56; 1 W
R1154	6-11009E81	22k
		switch assembly:
S1101	—	includes:
	40-84635C03	SWITCH, slide: dpdt, momentary
	1-80721D05	SWITCH ASSEMBLY, includes:
	40-84324C40	SWITCH, pushbutton: 1-section, w/lockout
	14-84360C01	INSULATOR, switch
S1102	1-80721D06	includes: (TRN4270A & TRN4271A)
	40-84324C06	SWITCH, pushbutton: 5-section
	14-84360C01	INSULATOR, switch; 5 used
S1103	1-80721D07	includes: (TRN4269A & TRN4271A)
	40-84324C01	SWITCH, pushbutton: 1-section
	14-84360C01	INSULATOR, switch
		integrated circuit: (see note)
U1101	51-82848M68	UART
U1102	51-82884L69	dual binary to 1-of-4 decoder
U1103	51-82848M48	PROM
U1105, 1106	51-84561L96	tristate buffer
U1107	51-82884L13	dual D flip-flop
U1108	51-84561L03	hex inverter
U1109	51-84371K94	quad OR gate
U1110	51-84371K74	quad comparator
U1111	51-84371K82	opto-isolator
		non-referenced items
	9-84924E02	SOCKET, IC: 16-contact
	2-10101A68	NUT, spring
	36-84900C02	KNOB, potentiometer
	1-80721D04	CIRCUIT BOARD ASSEMBLY includes:
	28-84269C01	CONTACT, male: low profile; 17 used
	28-84269C02	CONTACT, male; high profile; 15 used
	84-83451M01	PC BOARD, control head

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



NOTES

1. Unless otherwise indicated, resistance values are in ohms; capacitor values are in microfarads and inductor values are in millihenries.
2. This diagram shows positive logic.
3. Integrated circuits U1102, U1107, U1108, and U1109 on this board are CMOS devices.
4. Switches, lights, and resistors shown dashed lines are optional. Used on Kits TRN4270A and TRN4271A.
5. Switch is optional. Used on Kits TRN4270A and TRN4271A.
6. IC types and connections for this board are as follows:

Reference Designation	Type	VCC (+5 V)	Gnd	Mfgr's Description
U1101	TR1863B	18	3	UART
U1102	MC14556B	16	8	Dual Binary to 1-of-4 Decoder
U1103	82S123	16	8	PROM
U1105, U1106	80C97B	16	8	Tristate Buffer
U1107	MC14013B	14	7	Dual D Flip-Flop
U1108	74LS04	14	7	Hex Inverter
U1109	MC14071B	14	7	Quad OR Gate
U1110	LM339	3 (+12 V)	12	Quad Comparator, Optoisolator
U1111	4N33			

7. Waveforms shown are valid when control head is connected to a Trunked SYNTOR X Radio with Cable Kit.

Jumper Tables

Jumper	Remarks
JU1101	Dependent on Handset Use
JU1102	Dependent on Handset Use
JU1103	Minimum Volume Jumper
JU1104	Minimum Volume Jumper

JU1101	JU1102	Function
Out	Out	Switched Handset Audio, Switched Speaker Audio
Out	In	Continuous Handset Audio, Switched Speaker Audio
In	Out	Switched Handset Audio, Continuous Speaker Audio
In	In	Continuous Handset Audio, Continuous Speaker Audio

LEGEND

= Theory of Operation Data

Worst Case Output Logic Levels

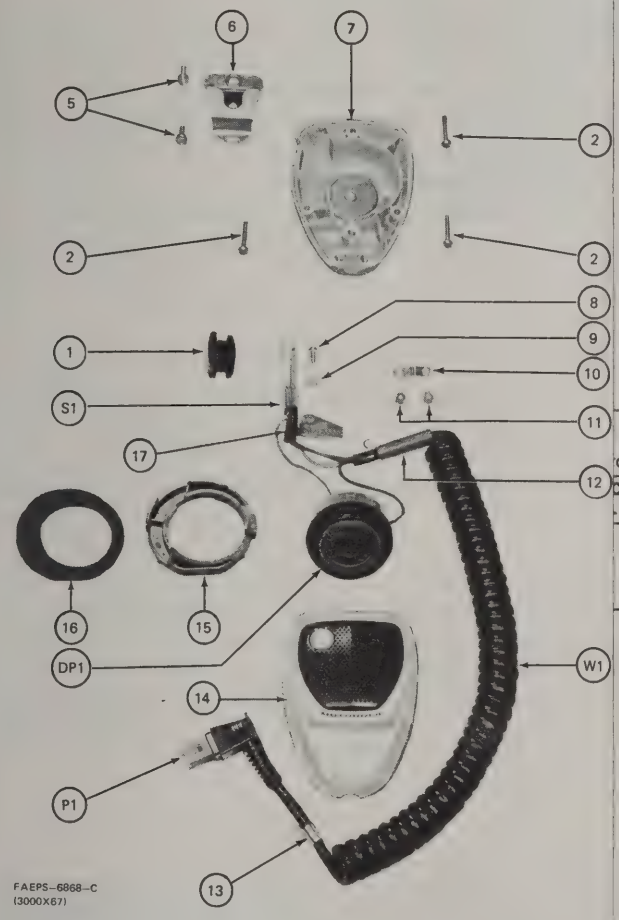
IC	Minimum Logic "1"	Maximum Logic "0"
U1101 TR1863B	2.4 V	0.4 V
U1102 MC14556B	4.7 V	.05 V
U1103 82S123	2.4 V	0.4 V
U1105, U1106 80C97B	4.7 V	.05 V
U1107 MC14013B	4.7 V	.05 V
U1108 74LS04	2.5 V	0.4 V
U1109 MC14071B	4.7 V	.05 V

Trunked Mobile Control Head
Schematic Diagram
Motorola No. ***EEPS-29391-A***
10/30/80-PHI

CONTROL BOARD

MOBILE MICROPHONE

The mobile microphone contains the microphone e
ment and a push-to-talk (PTT) switch. The micropho
element converts speech to transmit audio signals f
the radio. The PTT switch controls the radio transm
ter. The microphone is supplied with a hang-up clip.



bile Speaker (8 ft. cables)
bile Speaker (25 ft. cables) PL-6848-O

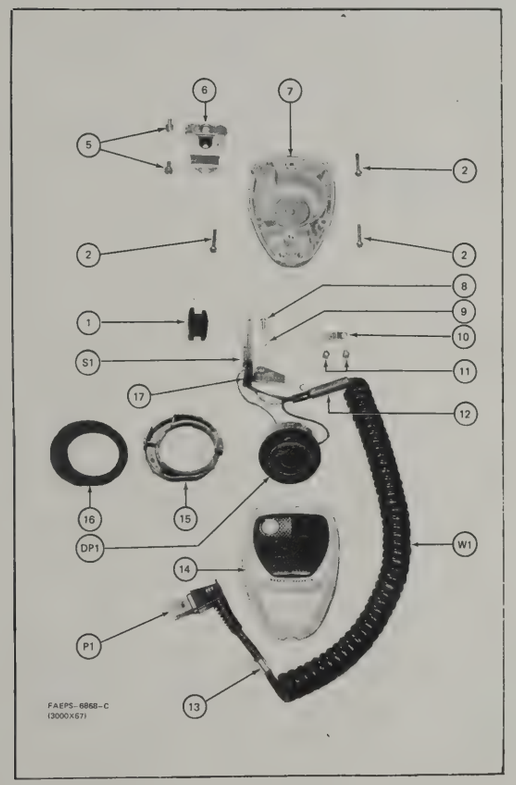
MOTOROLA PART NO.	DESCRIPTION
1V80702T45	HOUSING ASSEMBLY (rear): includes 15D84981B07 HOUSING (rear): 3-140001 SCREW, tapping: 6-19 x 7/8"; "Phillips" pan head; 4 req'd. 3-132436 SCREW, machine: 6-32 x 13/16"; 4 used
7C84568B02	BRACKET, trunnion
3S136756	SCREW, tapping: #10 x 5/8" plain hex head; 3 req'd.
3B84244C01	THUMBSCREW, machine: 10-32 x 3/8"; 2 req'd.
50D84561B01	LOUDSPEAKER, magnetic: 5"; "pincushion" type; 15 watt
32C84564B01	GASKET, speaker-mounting
13B82671M04	BEZEL, speaker
	CONNECTOR, plug: female; consists of: 14C84566B01 BODY, connector 9C84151B03 TERMINAL, contact; 2 req'd.
42B82018H05	RETAINER, cable entrance
42A84081A03	CLAMP, cable: includes "S" hook
1V80709B98	CABLE ASSEMBLY: includes 30C83155H01 CABLE, 2-conductor (8 ft.); each conductor #18 ga. stranded ("zip" cord); also includes coded items 9 and 11 (HSN4005A)
or 1V80717B50	CABLE ASSEMBLY: includes 30C83155H01 CABLE, 2-conductor (25 ft.); each conductor #18 ga. stranded ("zip" cord); also includes coded items 9 and 11 (HSN4006A)

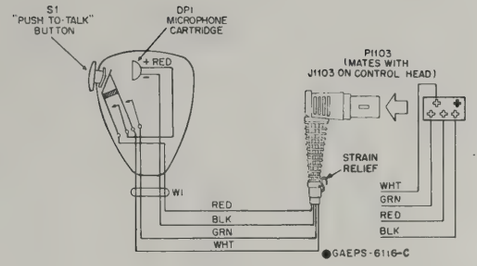
dware Kit PL-6206-A

CE MOTOROLA PART NO.	DESCRIPTION
7-84569B01	BRACKET, wall mounting
7-84567B01	BRACKET, hanger
3-121103	SCREW, machine: 6-32 x 3/8"
3-3660	SCREW, tapping: 6-20 x 1/2"; 2 used.

MOBILE MICROPHONE

The mobile microphone contains the microphone element and a push-to-talk (PTT) switch. The microphone element converts speech to transmit audio signals for the radio. The PTT switch controls the radio transmitter. The microphone is supplied with a hang-up clip.





parts list

HMN4002A Microphone — PL-6849-O

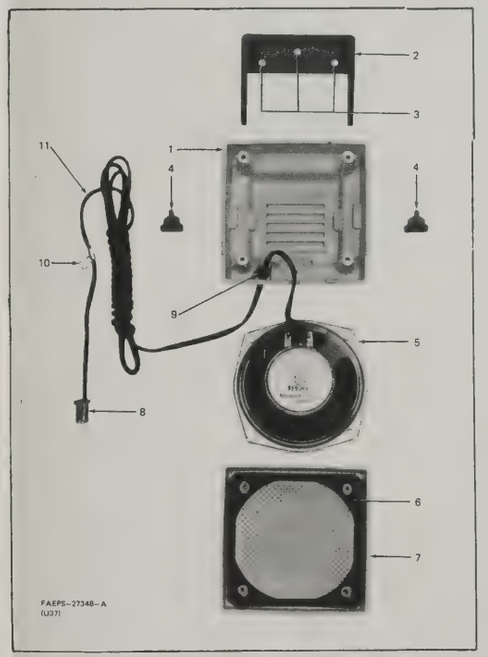
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		cartridge, microphone:
DP1	59-83272G01 or 59-84013A01 or 59-82933C02	dynamic: includes transistor preamplifier
		connector, plug:
P1103		part of W1
		cord, microphone: coiled:
W1	1-84135C01	4-conductor; includes ref. part P1, CLAMP, cable "S" hook (ref. part 13), SPRING, strain relief (ref. part 12), and non-ref. LUG (4 req'd.) 29B83277G02
		switch, push:
S1	40-82263G02	dpst

HMN4002A Microphone Mechanical Parts — PL-6850-A

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	38A84559B03	PUSHBUTTON
2	3S140000	SCREW, tapping: #6-19 x 3/8"; 3 used
5	3-139913	SCREW, tapping: #8-18 x 1/2"; 2 used
6	1V8070705	BRACKET & SPRING ASSY. (eyeletted)
7	1-80702T35	HOUSING, microphone, rear (PEARL)
8	3S129498	SCREW, lock; #6-32 x 5/16" "Phillips" round head
9	4S7666	LOCKWASHER: #6 external
10	42A852710	STRAP, strain relief
11	3S139999	SCREW, tapping: #6-19 x 3/4" "Phillips" round head; 2 used
12	41A852707	SPRING, strain relief (p/o W1)
13	42A893647	CLAMP, cable "S" hook (p/o W1)
14	15-82662M23	HOUSING, microphone, front
15	42B82702B02	RETAINER, cartridge
16	32A82703B01	GASKET, neoprene
17	11S2506	TUBING, #9 black; 5" length used
		non-coded items
	3-124693	SCREW, machine: 6-32 x 1/4"; 2 used
	3-132436	SCREW, machine: 6-32 x 3/16"; 3 used
	3-139999	SCREW, tapping: 6-32 x 3/8"; 3 used
	4-7669	WASHER, lock: #6 split; 3 used
	4-114201	WASHER, flat; 3 used
	13-83174B02	EMBLEM
	35-82652K01	BAFFLE, microphone
	33-82599D01	NAMEPLATE
	29-83277G02	LUG, insulation (p/o W1); 4 used

SPEAKER

The mobile speaker provides the audio output from the radio. It is equipped with its own trunnion bracket and may be mounted on the firewall or dashboard near the radio. The speaker is mounted in a strong, weather-resistant housing.



ACCESSORIES

HSN4005A Mobile Speaker (8 ft. cables)
HSN4006A Mobile Speaker (25 ft. cables) — PL-6848-O

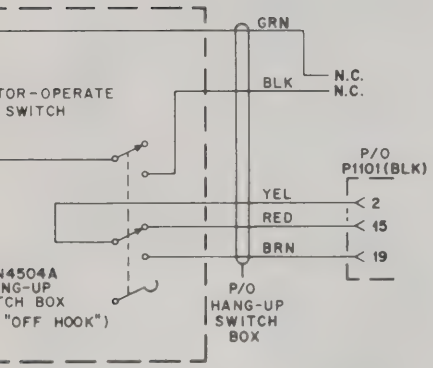
CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	1V80702T45	HOUSING ASSEMBLY (rear): includes 15D84981B07 HOUSING (rear): 3-140001 SCREW, tapping: 6-19 x 7/8"; "Phillips" pan head; 4 req'd. 3-132436 SCREW, machine: 6-32 x 13/16"; 4 used
2	7C84568B02	BRACKET, trunnion
3	3S136756	SCREW, tapping: #10 x 5/8" plain hex head; 3 req'd.
4	3B84244C01	THUMBSCREW, machine: 10-32 x 3/8"; 2 req'd.
5	50D84561B01	LOUDSPEAKER, magnetic: 5"; "pincushion" type; 15 watt
6	32C84564B01	GASKET, speaker-mounting
7	13B82671M04	BEZEL, speaker
8		CONNECTOR, plug: female; consists of 14C84566B01 BODY, connector 9C84151B03 TERMINAL, contact; 2 req'd
9	42B82018H05	RETAINER, cable entrance
10	42A84081A03	CLAMP, cable: includes "S" hook
11	1V80709B98	CABLE ASSEMBLY: includes 30C83155H01 CABLE, 2-conductor (8 ft.); each conductor #18 ga. stranded ("zip" cord); also includes coded items 9 and 11 (HSN4005A)
	or 1V80717B50	CABLE ASSEMBLY: includes 30C83155H01 CABLE, 2-conductor (25 ft.); each conductor #18 ga. stranded ("zip" cord); also includes coded items 9 and 11 (HSN4006A)

TRN8588A Hardware Kit — PL-6206-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	7-84569B01	BRACKET, wall mounting
	7-84567B01	BRACKET, hanger
	3-121103	SCREW, machine: 6-32 x 3/8"
	3-3660	SCREW, tapping: 6-20 x 1/2"; 2 used.

T HANGUP BOX

4504A and TLN4505A Handset used to transfer audio from the e handset receiver when the handset The Model TLN4505A Handset with carrier squelch radios and per-lio switching function. The Model t Hangup Box is used with PL or ludes a monitor slide switch. When e monitor position, PL squelch is eiver operates in the carrier squelch r switch is not used for trunked

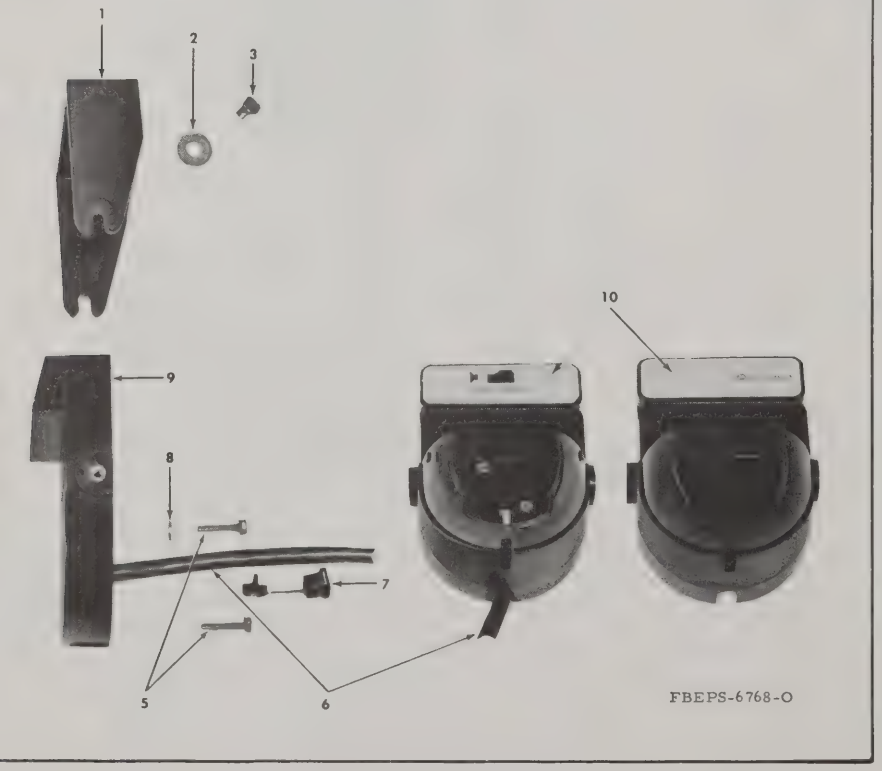


• BEPS-31119-O

parts list

TLN4504A Handset Hangup Switch Box
TLN4505A Handset Hangup Cradle PL-2240-A

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	7C84568B02	BRACKET, trunnion
2	4S1724	WASHER, flat: 0.234" x 0.625" x .048"; 2 used
3	3S7302	SCREW, machine: 10-32 x 3/8" "Phillips" hex head; 2 used
4	15C84520C01	HANG-UP CUP & SWITCH ASSEMBLY (TLN4504A)
	or 15C84520C02	HANG-UP CUP (TLN4505A)
5	3S135507	SCREW, machine; 6-32 x 3/4" "Phillips" hex head; 4 used
6	1V80717B42	CABLE ASSEMBLY: includes attached insertable connector contacts (TLN4504A)
7	42B82018H08	ANCHOR, cable strain relief
8	4S1720	WASHER, flat; 0.156" x 0.375" x .030"; 2 used
9	1V80717B40	MOUNTING BASE & SWITCH ASSEMBLY (TLN4504A)
10	13B84515C01	ESCUTCHEON (TLN4504A)
	or 13-84515C02	ESCUTCHEON (TLN4505A)
	non-coded items	
	42B82018H08	RETAINER, cable
	3S136756	SCREW, tapping: 10 x 5/8"; 3 used
	38B84383D02	CAP, protective; 3 used
	3-138392	SCREW, tapping; 8-18 x 1-3/4"; 2 used
	9-84151B03	RECEPTACLE, contact; 3 used
	14-84556B02	HOUSING, connector: blu



FBEPS-6768-O

MOTOROLA INC.
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TRUNKED SYNTOR X MULTIPLE SYSTEM SELECT

OPTION W305AA, W305AB,
W305AC, W305AD

1. GENERAL DESCRIPTION

The Trunked SYNTOR X Multiple System Select Option W305AA, AB, AC, AD allows an operator to select up to five different trunked systems or fleets. A typical "system" consists of a system central controller and up to 20 trunked repeaters. A "fleet" consists of a set of subfleets which can have several individual users. The multiple system select option permits an operator to access up to five systems or fleets in a local area or in various geographical regions. With the addition of a volume set and/or five subfleet select option, additional capabilities are possible.

Figure 1 shows a trunked control head with the volume set and five subfleet option in addition to the W305AD multiple system select option. With this combination, an operator may select any one of up to five subfleets or five fleet/subfleet combinations in any one of five systems.

The basic Trunked SYNTOR X Multiple System Select option consists of a multiple system select board with up to five code plugs and an escutcheon and hardware kit. Three additional option combinations are available. The options table below defines the details of the four options.

The multiple system select board mounts inside the control head housing. The five system select pushbuttons and associated indicator lights mount at the top front of the control head as shown in Figure 1.

A secondary function of the multiple system select board is to act as an interface for a 7 or 15 subfleet select option and a phone patch board option; if applicable. When the phone patch option is used, a telephone line may be accessed via the mobile radio system. When the 7 subfleet or 15 subfleet option is used in conjunction with the five multiple system select option, an operator may select seven subfleets plus one fleet or 15 subfleets and one fleet in each of the five systems. The 7 or 15 subfleet option is described in detail in section 68P81111E19-O of Trunked SYNTOR X FM Two-Way Radio service manual 68P81043E50.

2. OPERATING PROCEDURE

(Refer to Figure 1.)

Any one of up to five systems or fleets can be selected by depressing the desired system select pushbutton. The associated indicator light illuminates at high intensity. If no pushbutton is depressed, system

Options Table for Trunked SYNTOR X Mobile Radio

Option	Add	Delete	Applicability	Remarks
W305AA	TLN2319A* TRN4569A	TRN4264A	All single subfleet units w/o volume set	Provides selection of up to five different systems or fleets.
W305AB	TLN2319A* TRN4570A	TRN4265A	All single subfleet units with volume set	Provides selection of up to five different systems or fleets with the volume set option.
W305AC	TLN2319A* TRN4571A	TRN4266A	All five subfleet units w/o volume set	Provides selection of up to five different systems or fleets with the five subfleet select option.
W305AD	TLN2319A* TRN4572A	TRN4267A	All five subfleet units with volume set	Provides selection of up to five different systems or fleets with the five subfleet select and volume set options.

*TLN2319A consists of (1) Multiple System Select Board TRN4573A, (2) Clip Kit TRN4464A, (3) Spare Button and Button Stop Kit TRN4273A, and (4) Code Plug TRN4263A.

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HANDSET

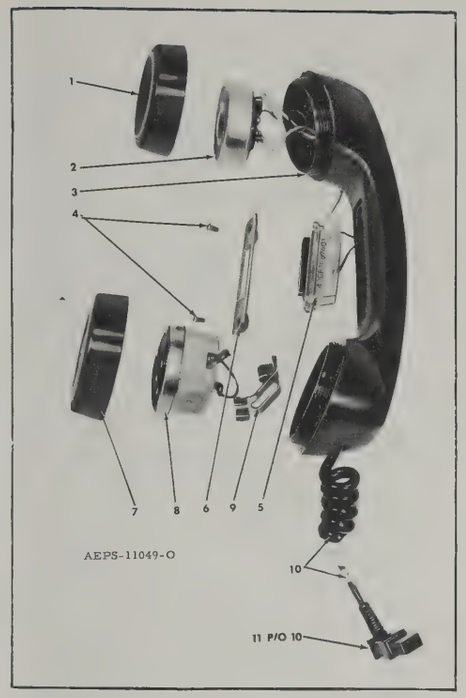
The TMN6152A Handset is used in installations where a telephone-style handset is preferred to the mobile microphone and speaker. The unit operates in the same manner as a telephone handset except that it has a PTT button which is used to key the radio.

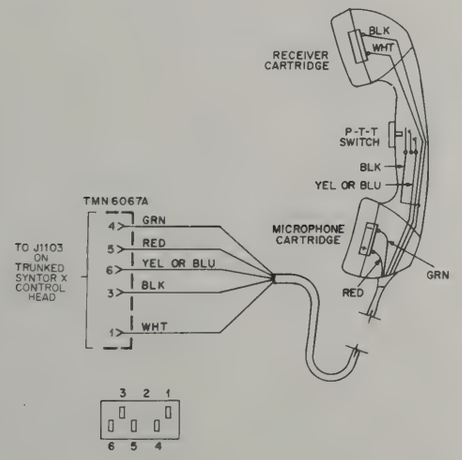
parts list

TMN6152A Handset — PL-2241-B

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	15B84054A01	CAP, receiver (see note)
2	59C84058A01	CARTRIDGE, receiver
3	15C84059A01	HANDLE (see note)
4	3S124432	SCREW, machine: 4-40 x 1/4" "Phillips" flat head; 2 req'd.
5	40C84087A01	SWITCH, push: includes pushbutton and dust cover
6	15B84053A01	PLATE, switch cover
7	15B84055A01	CAP, transmitter (see note)
8	59B83272G01	MICROPHONE ELEMENT, telephone:
	or 59D82933C02	dynamic type
9	7B83352H01	BRACKET, cord retaining
10	30-83739M01	CORD ASSEMBLY: includes a "molded-on" 5-contact female connector
11		CONNECTOR, plug: (part of Item 10)

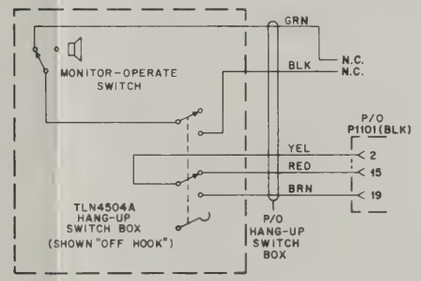
note: A replacement handle, plus transmit and receiver caps, can be obtained by ordering part no. 15C84107A01.





HANDSET HANGUP BOX

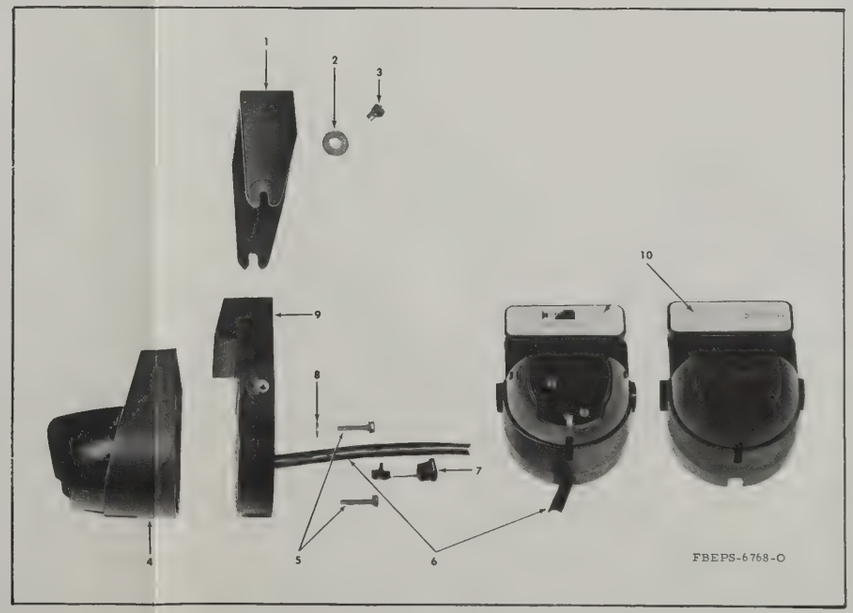
The Models TLN4504A and TLN4505A Handset Hangup Boxes are used to transfer audio from the mobile speaker to the handset receiver when the handset is lifted off-hook. The Model TLN4505A Handset Hangup Box is used with carrier squelch radios and performs only the audio switching function. The Model TLN4504A Handset Hangup Box is used with PL or DPL radios and includes a monitor slide switch. When this switch is in the monitor position, PL squelch is disabled and the receiver operates in the carrier squelch mode. The monitor switch is not used for trunked radios.



parts list

TLN4504A Handset Hangup Switch Box
TLN4505A Handset Hangup Cradle — PL-2240-A

CODE NUMBER	MOTOROLA PART NO.	DESCRIPTION
1	7C84568B02	BRACKET, trunnion
2	4S1724	WASHER, flat: 0.234" x 0.625" x .048"; 2 used
3	3S7302	SCREW, machine: 10-32 x 3/8" "Phillips" hex head; 2 used
4	15C84520C01	HANG-UP CUP & SWITCH ASSEMBLY (TLN4504A)
	or 15C84520C02	HANG-UP CUP (TLN4505A)
5	3S135507	SCREW, machine; 6-32 x 3/4" "Phillips" hex head; 4 used
6	1V80717B42	CABLE ASSEMBLY: includes attached insertable connector contacts (TLN4504A)
7	42B82018H08	ANCHOR, cable strain relief
8	4S1720	WASHER, flat; 0.156" x 0.375" x .030"; 2 used
9	1V80717B40	MOUNTING BASE & SWITCH ASSEMBLY (TLN4504A)
10	13B84515C01	ESCUTCHEON (TLN4504A)
	or 13-84515C02	ESCUTCHEON (TLN4505A)
		non-coded items
	42B82018H08	RETAINER, cable
	3S136756	SCREW, tapping: 10 x 5/8"; 3 used
	38B84383D02	CAP, protective; 3 used
	3-138392	SCREW, tapping; 8-18 x 1-3/4"; 2 used
	9-84151B03	RECEPTACLE, contact; 3 used
	14-84556B02	HOUSING, connector: blu



MOTOROLA INC.
Communications
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TRUNKED SYNTOR X MULTIPLE SYSTEM SELECT

OPTION W305AA, W305AB,
W305AC, W305AD

1. GENERAL DESCRIPTION

The Trunked SYNTOR X Multiple System Select Option W305AA, AB, AC, AD allows an operator to select up to five different trunked systems or fleets. A typical "system" consists of a system central controller and up to 20 trunked repeaters. A "fleet" consists of a set of subfleets which can have several individual users. The multiple system select option permits an operator to access up to five systems or fleets in a local area or in various geographical regions. With the addition of a volume set and/or five subfleet select option, additional capabilities are possible.

Figure 1 shows a trunked control head with the volume set and five subfleet option in addition to the W305AD multiple system select option. With this combination, an operator may select any one of up to five subfleets or five fleet/subfleet combinations in any one of five systems.

The basic Trunked SYNTOR X Multiple System Select option consists of a multiple system select board with up to five code plugs and an escutcheon and hardware kit. Three additional option combinations are available. The options table below defines the details of the four options.

The multiple system select board mounts inside the control head housing. The five system select pushbuttons and associated indicator lights mount at the top front of the control head as shown in Figure 1.

A secondary function of the multiple system select board is to act as an interface for a 7 or 15 subfleet select option and a phone patch board option; if applicable. When the phone patch option is used, a telephone line may be accessed via the mobile radio system. When the 7 subfleet or 15 subfleet option is used in conjunction with the five multiple system select option, an operator may select seven subfleets plus one fleet or 15 subfleets and one fleet in each of the five systems. The 7 or 15 subfleet option is described in detail in section 68P81111E19-O of Trunked SYNTOR X FM Two-Way Radio service manual 68P81043E50.

2. OPERATING PROCEDURE

(Refer to Figure 1.)

Any one of up to five systems or fleets can be selected by depressing the desired system select pushbutton. The associated indicator light illuminates at high intensity. If no pushbutton is depressed, system

Options Table for Trunked SYNTOR X Mobile Radio

Option	Add	Delete	Applicability	Remarks
W305AA	TLN2319A* TRN4569A	TRN4264A	All single subfleet units w/o volume set	Provides selection of up to five different systems or fleets.
W305AB	TLN2319A* TRN4570A	TRN4265A	All single subfleet units with volume set	Provides selection of up to five different systems or fleets with the volume set option.
W305AC	TLN2319A* TRN4571A	TRN4266A	All five subfleet units w/o volume set	Provides selection of up to five different systems or fleets with the five subfleet select option.
W305AD	TLN2319A* TRN4572A	TRN4267A	All five subfleet units with volume set	Provides selection of up to five different systems or fleets with the five subfleet select and volume set options.

*TLN2319A consists of (1) Multiple System Select Board TRN4573A, (2) Clip Kit TRN4464A, (3) Spare Button and Button Stop Kit TRN4273A, and (4) Code Plug TRN4263A.

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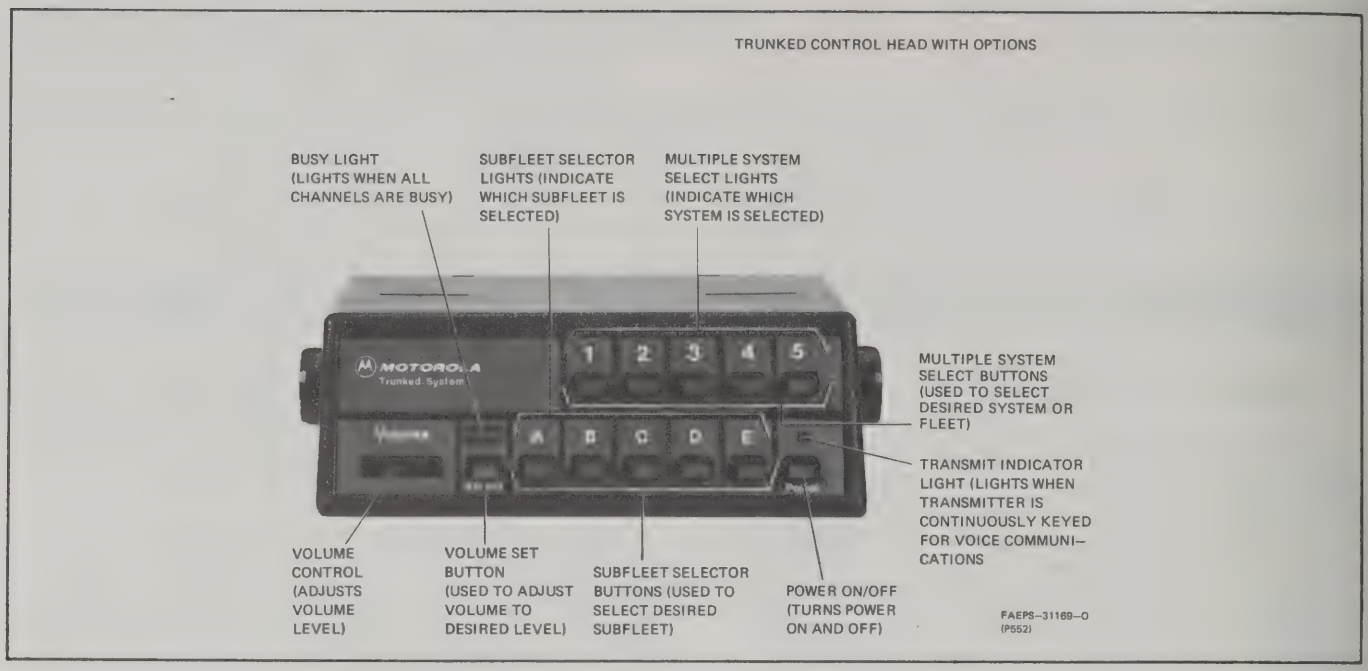


Figure 1. Trunked SYNTOR X Control Head with Multiple System Select Option W305AD and Five Subfleet Select and Volume Set Options

one is selected. There is a wait of approximately one second before the mobile can receive and transmit calls after a system selection is made.

Once the system is selected, the subfleet selector pushbuttons may be depressed to access the individual subfleet or fleet desired in the system.

3. THEORY OF OPERATION

(Refer to schematic diagram EEPS-31066)

3.1 CODE PLUG CIRCUITRY

All five code plugs are connected to both the transmit data bus and the receive data bus. The receive data bus is composed of bits RD0 through RD4 which are used for code plug addresses A0 through A4. The five address lines permit the addressing of the entire 32 bytes of the code plug (PROM). The transmit data bus transfers the 8-bit words to the UART (Universal Asynchronous Receiver Transmitter), located on the control board where they are serialized for transmission via the serial link to the microprocessor on the trunked personality board in the radio.

Only one code plug is enabled on the transmit data bus at any one time to prevent bus contention. This is achieved through the use of an interlocked switch (S1201) where only one button can be depressed at a time.

The $\overline{\text{C.P. SELECT}}$ (Code Plug Read) input from the microprocessor is used to enable the code plug during a read cycle. Operating power for the code plug (V_{CC}) is supplied only when a code plug select command is being executed. Operating power for each code plug is controlled by a three-state buffer, pull-up resistor, and a PNP transistor.

When a system select pushbutton (S1201) is depressed, the input of one of the three-state code plug select buffers is grounded; for example, U1203A-2. When the $\overline{\text{C.P. SELECT}}$ input goes low, all the three-state buffers are enabled, but in this example, only the output of U1203A goes low. The low output at U1203A-3 pulls $\overline{\text{CS}}$ low at U1204-15 and turns on Q1202. Q1202 supplies between +5 V to U1204-16. This action fully enables U1204 allowing it to be addressed and its contents to be transferred to the UART on the control board. The code plug is powered up every 23 ms. After the code plug has been read, the $\overline{\text{C.P. SELECT}}$ line goes high removing the low $\overline{\text{CS}}$ input to the code plug and +5 V from the code plug PWR input.

3.2 SERIAL LINK DRIVER

The contacts of the system select switch S1201 are a break-before-make type. Therefore, when a system select pushbutton is depressed, a high to low logic level transition occurs at the clock input of U1201A and through C1201 to U1202B-5. This action causes the output of U1202B to go high for 0.22 ms which sets flip-flop U1201A. U1201A-2 then goes low which allows U1201B to be toggled by the $\overline{\text{C.P. SELECT}}$ input at U1201B-13 and pulls $\overline{\text{POLLED DATA}}$ low through CR1203. The low $\overline{\text{POLLED DATA}}$ input is routed to the UART in the control head. The UART transfers the low $\overline{\text{POLLED DATA}}$ input to the microprocessor which

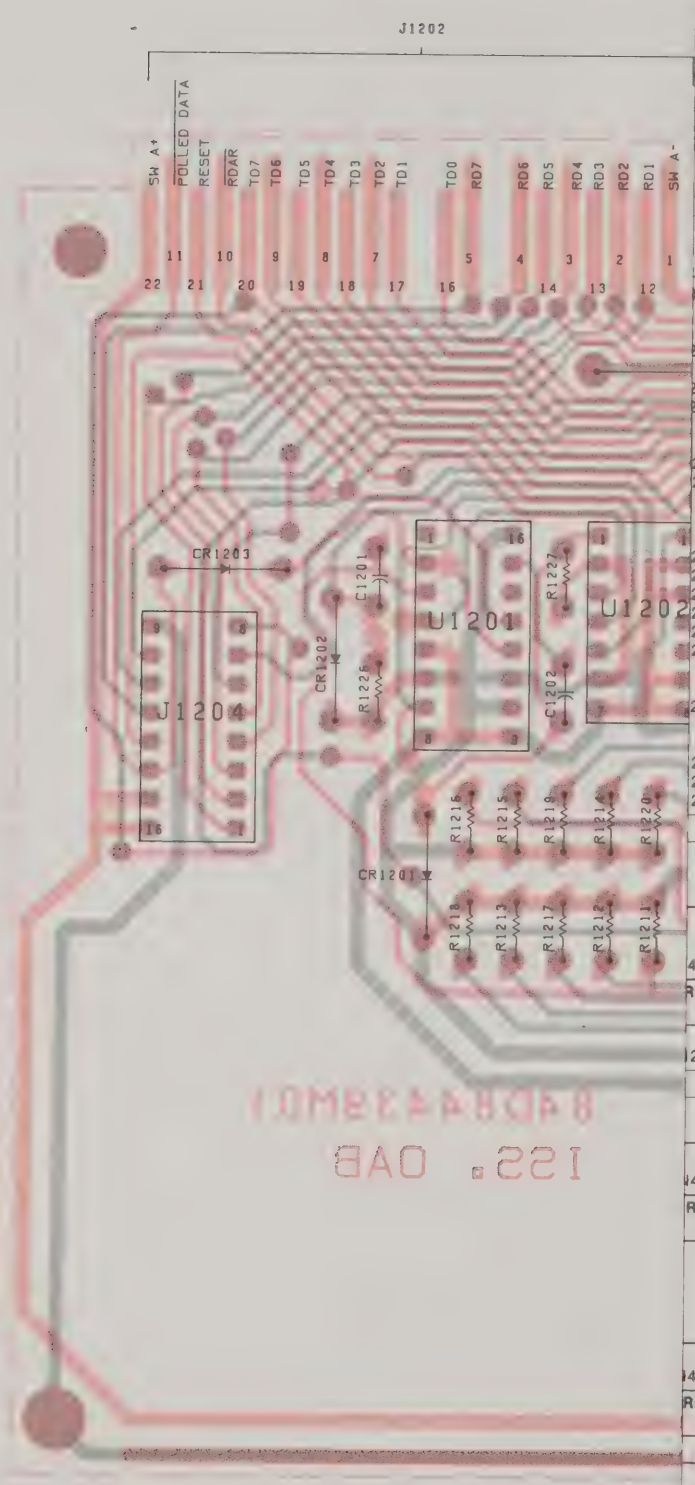
initiates a code plug read action to load the microprocessor's RAM with data from the newly selected code plug.

The initial $\overline{\text{POLLED DATA}}$ pulse started by the S1201 switching action could occur anytime during the $\overline{\text{C.P. SELECT}}$ pulse read cycle. To assure a full 23 ms of code plug read time, the microprocessor initiates the first of two $\overline{\text{C.P. SELECT}}$ pulses. The first pulse applied to the clock input of U1201B causes the Q output to toggle high. The second $\overline{\text{C.P. SELECT}}$ pulse at the clock input of U1201B causes the Q output to toggle low which produces a 0.22 ms high at U1202A-3. The high output of U1202A resets U1201A. When U1201A resets, the $\overline{\text{Q}}$ output goes high resetting U1201B and allows $\overline{\text{POLLED DATA}}$ pulse to go high to complete a 23 ms read cycle. The entire process is repeated whenever S1201 is operated to select a different system.

3.3 POWER SUPPLY

Q1201 and associated circuitry convert the SW A+ input to a regulated +5 V ouput for application throughout the circuit board.

MULTIPL rts list



Trunked SYNTOR X Multiple System Select
Option W305AA, AB, AC, AD,
Circuit Board Detail and Parts List
Motorola No. ***PEPS-31149-O***
(Sheet 1 of 2)
11/15/80-PHI

573A Multiple System Select Board — PL-7148-O

EFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
201, 1202	21-11015A07	.01 uF + 80-20%; 100 V
203	23-83210A08	100 uF + 150-10%; 25 V
204, 1205	21-82372C01	0.1 uF + 80-20%; 25 V
		diode: (see note)
1201, 1202	48-84616A01	silicon (hot carrier)
1203	48-83654H01	silicon
		lamp:
-1201 thru 05	65-84047E01	10 V; clear
		connector, receptacle: consists of:
201, 1202	28-84269C01	male; low profile; 10 used
	28-84269C02	male; high profile; 10 used
203	30-83776M01	flat cable; 14 pin
204	30-84799M01	flat cable; 16 pin
		transistor: (see note)
201	51-84561L76	voltage regulator; 5 V
202 thru 1206	48-869649	PNP; type M9649
		resistor, fixed: ± 5%; 1/8 W; unless otherwise stated:
201 thru 1205	6-126A19	56; 1 W
206 thru 1210	6-125A29	150; 1/2 W
211 thru 1220	6-11009E81	22k
221 thru 1225	6-11009E57	2.2k
226, 1227	6-11009E81	22k
228	6-11009E09	22
		switch:
201	40-84324C06	pushbutton; 5 section
		integrated circuit: (see note)
201	51-82884L10	type M8410; dual JK flip-flop
202	51-82884L66	type M8466; Quad NAND Schmitt Trigger
203	51-84561L96	type M6196; three-state buffer
		mechanical parts
	14-84360C01	INSULATOR, switch; 5 used
	9-84924E02	SOCKET, 16 contact; 5 used
	75-82663M02	PAD, foam; 5 used

4263A Code Plug, Trunking — PL-7149-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
204 thru 1208	51-82848M48	type M4848
		mechanical parts
	42-82660M01	CLIP, 16-contact
	75-82663M02	PAD, foam

4464A Sockets (2) and Clips — PL-7150-O

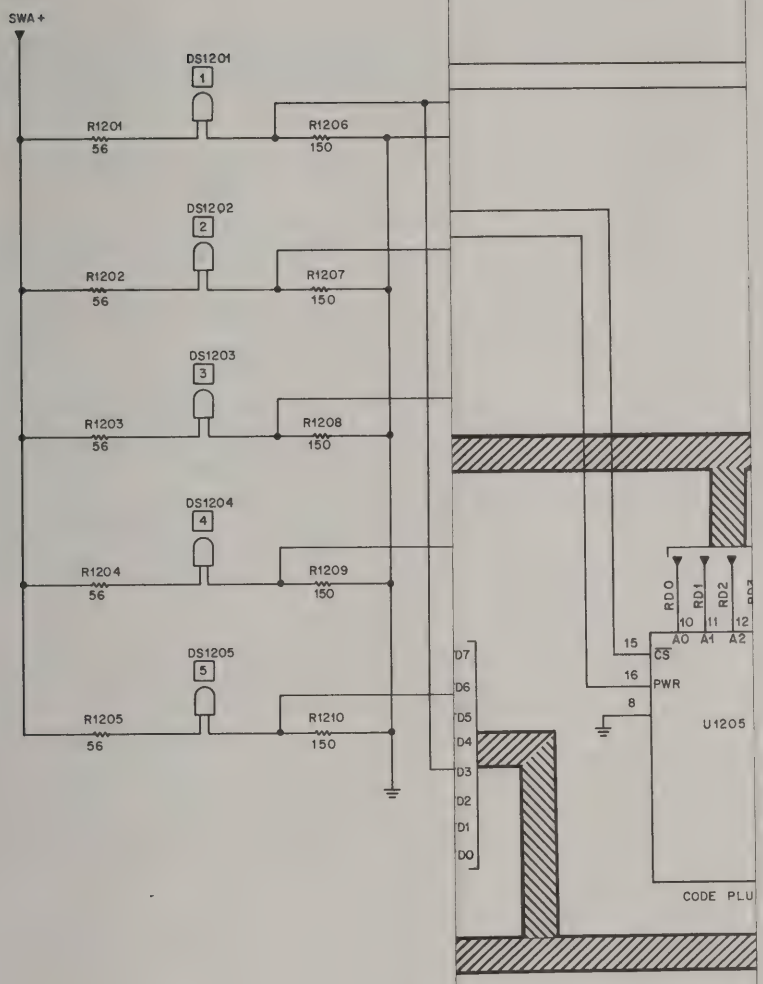
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	9-84924E02	SOCKET, 16-contact; 11 used
	9-84924E05	SOCKET, 14-contact
	42-82660M01	CLIP, 16-contact plug
	42-82660M05	CLIP, 14-contact plug
	75-82663M02	PAD, foam; 2 used

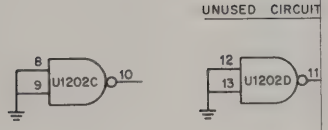
4273A Button Spare and Button Stop — PL-7151-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	38-84617C01	BUTTON, stop

4569A Escutcheon and Hardware Basic with Multiple System Select
4570A Escutcheon and Hardware with Volume Set and Multiple System Select
4571A Escutcheon and Hardware Subfleet and Multiple System Select
4572A Escutcheon and Hardware with Subfleet, Volume, and Multiple System
ct — PL-7152-O

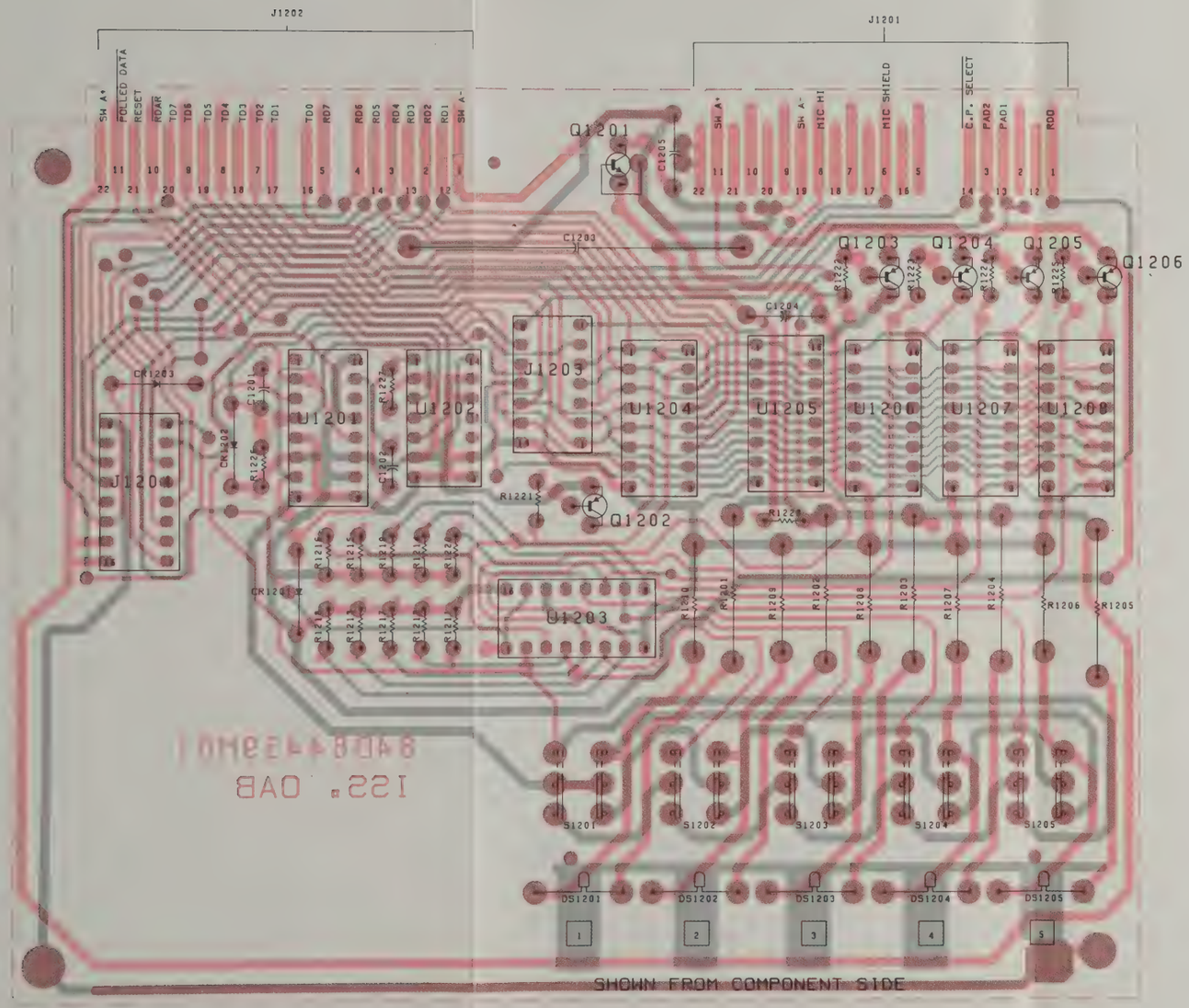
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	13-83772M02	ESCUTCHEON; (TRN4569A)
	13-83772M03	ESCUTCHEON (TRN4570A)
	13-83772M04	ESCUTCHEON (TRN4571A)
	13-83772M05	ESCUTCHEON (TRN4572A)
	13-83772M06	ESCUTCHEON (All Models)
	38-80029B02	BUTTON, push (1 used on TRN4569A and TRN4571A) (2 used on TRN4570A and TRN4572A)
	38-80029B03	BUTTON, push (5 used on TRN4569A and TRN4570A) 10 used on TRN4571A and TRN4572A





Trunked SYNTOR X Multiple System Select Board TRN4573A Schematic Diagram
Motorola No. ***PEPS-31149-O***
(Sheet 2 of 2)
11/15/80-PHI

MULTIPLE SYSTEM SELECT BOARD TRN4573A



COMPONENT SIDE 80-DEPS-31148-O
SOLDER SIDE 80-DEPS-31147-O
OL-DEPS-31146-O

Trunked SYNTOR X Multiple System Select
Option W305AA, AB, AC, AD,
Circuit Board Detail and Parts List
Motorola No. PEPS-31149-O
(Sheet 1 of 2)
11/15/80-PHI

parts list

TRN4573A Multiple System Select Board — PL-7148-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1201, 1202	21-11015A07	.01 uF + 80-20%; 100 V
C1203	23-83210A08	100 uF + 150-10%; 25 V
C1204, 1205	21-82372C01	0.1 uF + 80-20%; 25 V
		diode: (see note)
CR1201, 1202	48-84616A01	silicon (hot carrier)
CR1203	48-83654H01	silicon
		lamp:
DS-1201 thru 1205	65-84047E01	10 V; clear
		connector, receptacle: consists of:
J1201, 1202	28-84269C01	male; low profile; 10 used
	28-84269C02	male; high profile; 10 used
J1203	30-83776M01	flat cable; 14 pin
J1204	30-84799M01	flat cable; 16 pin
		transistor: (see note)
Q1201	51-84561L76	voltage regulator; 5 V
Q1202 thru 1206	48-869649	PNP; type M9649
		resistor, fixed: ± 5%; 1/8 W; unless otherwise stated:
R1201 thru 1205	6-126A19	56; 1 W
R1206 thru 1210	6-125A29	150; 1/2 W
R1211 thru 1220	6-11009E81	22k
R1221 thru 1225	6-11009E57	2.2k
R1226, 1227	6-11009E81	22k
R1228	6-11009E09	22
		switch:
S1201	40-84324C06	pushbutton; 5 section
		integrated circuit: (see note)
U1201	51-82884L10	type M8410; dual JK flip-flop
U1202	51-82884L66	type M8466; Quad NAND Schmitt Trigger
U1203	51-84561L96	type M6196; three-state buffer
		mechanical parts
	14-84360C01	INSULATOR, switch; 5 used
	9-84924E02	SOCKET, 16 contact; 5 used
	75-82663M02	PAD, foam; 5 used

TRN4263A Code Plug, Trunking — PL-7149-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U1204 thru 1208	51-82848M48	type M4848
		mechanical parts
	42-82660M01	CLIP, 16-contact
	75-82663M02	PAD, foam

TRN4464A Sockets (2) and Clips — PL-7150-O

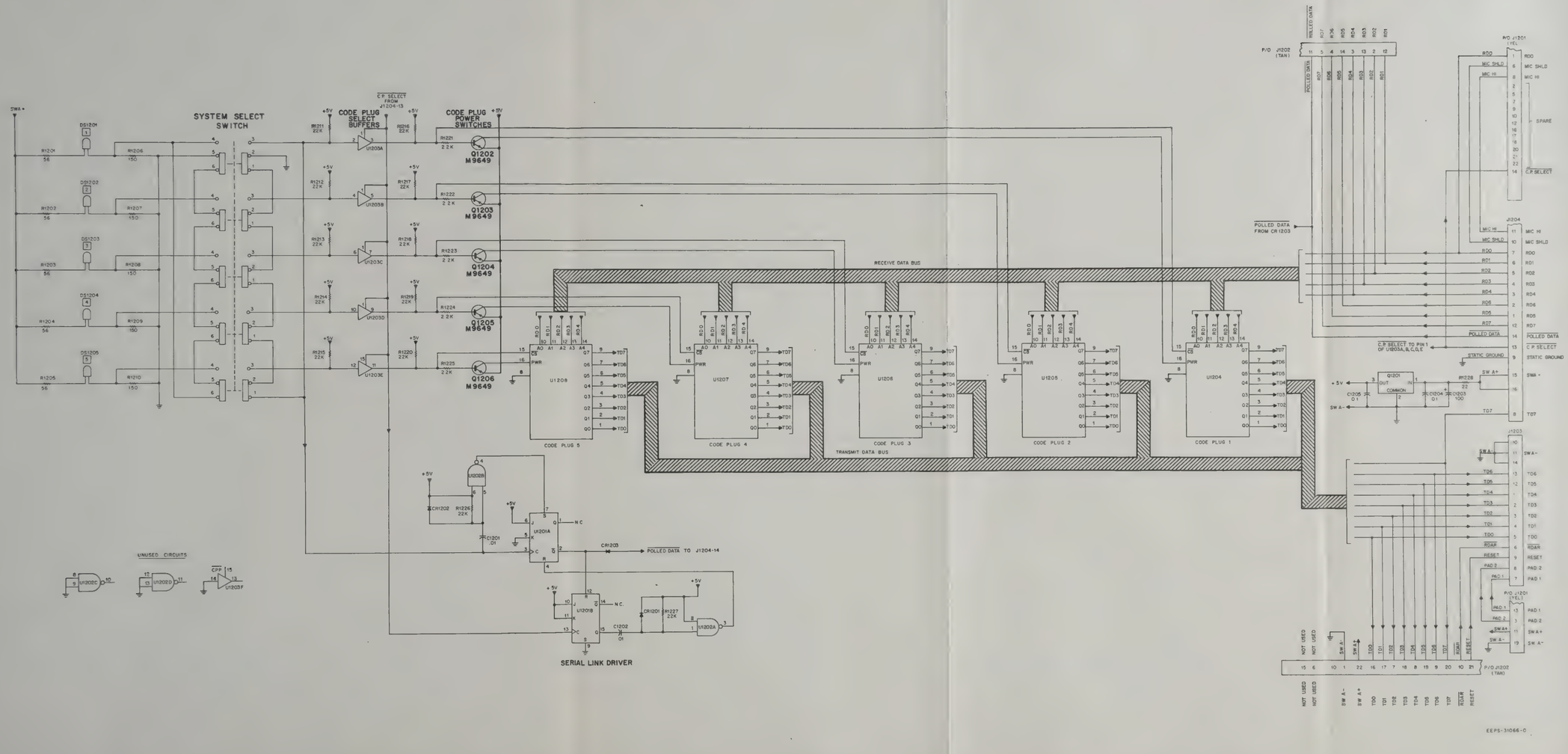
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	9-84924E02	SOCKET, 16-contact; 11 used
	9-84924E05	SOCKET, 14-contact
	42-82660M01	CLIP, 16-contact plug
	42-82660M05	CLIP, 14-contact plug
	75-82663M02	PAD, foam; 2 used

TRN4273A Button Spare and Button Stop — PL-7151-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	38-84617C01	BUTTON, stop

TRN4569A Escutcheon and Hardware Basic with Multiple System Select
TRN4570A Escutcheon and Hardware with Volume Set and Multiple System Select
TRN4571A Escutcheon and Hardware Subfleet and Multiple System Select
TRN4572A Escutcheon and Hardware with Subfleet, Volume, and Multiple System Select — PL-7152-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	13-83772M02	ESCUTCHEON; (TRN4569A)
	13-83772M03	ESCUTCHEON (TRN4570A)
	13-83772M04	ESCUTCHEON (TRN4571A)
	13-83772M05	ESCUTCHEON (TRN4572A)
	13-83772M06	ESCUTCHEON (All Models)
	38-80029B02	BUTTON, push (1 used on TRN4569A and TRN4571A) (2 used on TRN4570A and TRN4572A)
	38-80029B03	BUTTON, push (5 used on TRN4569A and TRN4570A) 10 used on TRN4571A and TRN4572A



*Trunked SYNTOR X Multiple System Select Board TRN4573A Schematic Diagram Motorola No. **PEPS-31149-O** (Sheet 2 of 2) 11/15/80-PHI*

MOTOROLA INC.
Communications Group

TRUNKED SYNTOR X 7 AND 15 SUBFLEET SELECT

OPTIONS W306AA AND W307AA

1. GENERAL DESCRIPTION

The Trunked SYNTOR X 15 Subfleet Select Option W306AA allows an operator to select up to 15 different subfleets or the entire fleet in a trunked system. The W307AA option allows the operator to select seven subfleets or the entire fleet in a trunked system. The 7/15 subfleet capability can be greatly expanded with the addition of the desired Trunked SYNTOR X Multiple System Select Option W305A( ). The multiple system select option provides access of up to five different trunked systems or fleets. Up to seven subfleets or the entire fleet, or 15 subfleets or the entire fleet can be selected in each of the system or fleets with these two options.

Figure 1 shows a 15 subfleet or one entire fleet configuration, Option W306AA. The 7/15 subfleet options mount on top of the trunked control head. Figure 2 shows the interconnecting cable which mounts from the rear of the 7/15 subfleet housing to the rear of the control head housing. Option W306AA requires two circuit boards, TRN4460A and TRN4461A. Option W307AA requires only circuit board TRN4462A.

2. OPERATING PROCEDURE

(Refer to Figure 1.)

Any one of up to 15 subfleets or the entire fleet may be selected by depressing the desired momentary pushbutton. The associated indicator light illuminates at high intensity. The seven subfleet option is continuously back lit. However, because of possible heat build-up, the 15 subfleet option is not back lit.

If no pushbuttons are depressed, a predetermined subfleet or entire fleet select position is accessed. This is accomplished by the pre-connection of a gray jumper wire to one of eight bubble head pins on the subfleet select boards (one of 16 bubble head pins on the two boards of a 15 subfleet select unit) inside of the option housing. This procedure is normally done either at the factory or by a field technician.

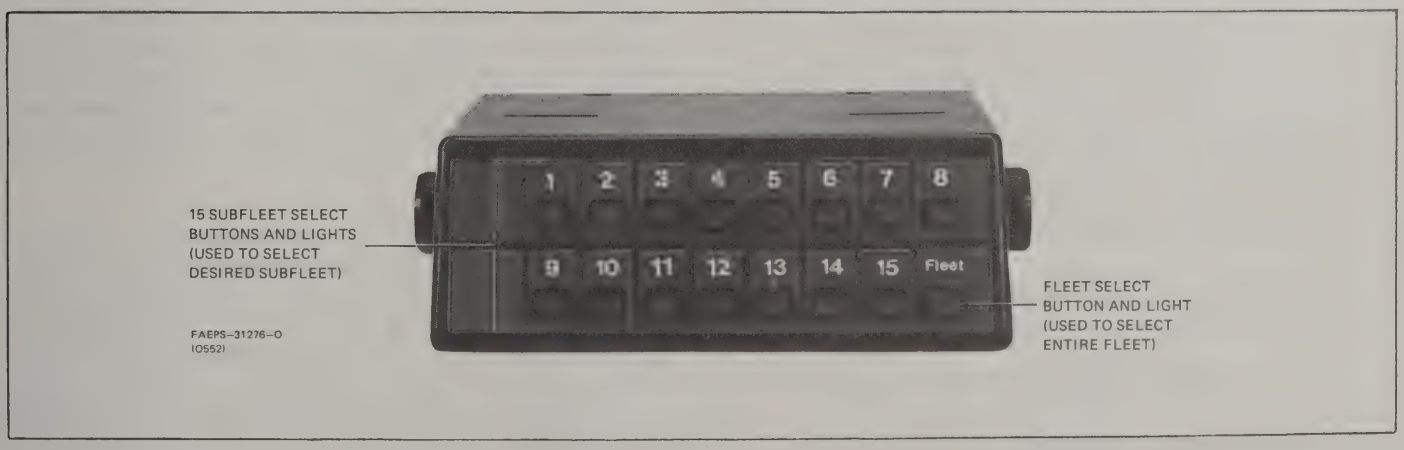
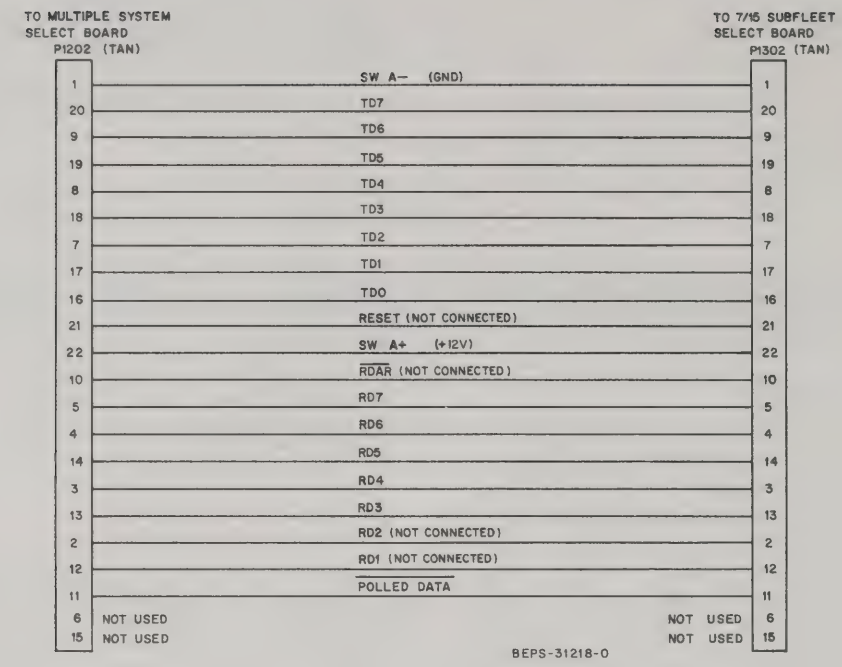


Figure 1.
Trunked SYNTOR X 15 Subfleet Select Option W306AA (Front View)

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

68P81111E19-A
1/15/81-PHI



3. THEORY OF OPERATION

(Refer to schematic diagram EEPS-31172.)

3.1 GENERAL

Sixteen subfleet switches are binary encoded into 4-bit words. When a subfleet is selected, the associated 4-bit word is transferred via the transmit data bus to the UART (Universal Asynchronous Receiver Transmitter), located on the control board, where it is serialized for transmission via the serial link to the microprocessor on the trunked personality board in the radio. This data is sent to the microprocessor every 800 ms or within 28 ms after a new subfleet is selected. The major functional blocks of the subfleet select option are:

- 4 of 16 Decoder and Decoder Control Counter (U1307, U1306A)
- Polled Data Flip-Flop (U1304)
- 1 of 4 Receive Decoder (U1305)
- Power Up Circuitry (U1303C, D)
- +5 V Regulator (Q10)

The functional blocks are described in the following.

3.2 4 OF 16 DECODER AND DECODER CONTROL COUNTER

The 4 of 16 decoder U1307 and decoder control counter U1306A interact with each other to select the desired 4-bit subfleet address. All the outputs of U1307 are normally held low until addressed via the ABCD input lines. Typical operation is as follows. When momentary pushbutton switch S8 is depressed on the lower board (selecting subfleet 9), the input to U1301F is pulled low through CR1312. The output of three-state buffer U1301F now goes low to provide an enable to start decoder control counter U1306A.

The binary output of U1306A provides an incrementing address to the ABCD input lines of U1307. The outputs of U1307 go high one at a time corresponding to the binary address applied to the input. When the output of U1307 goes high corresponding to the subfleet switch depressed, the high logic level is applied to U1301F-14. This high is transferred through U1301F to the clock input of U1306A which disables the decoder control counter. Since S8 is depressed in this example, the high output of U1307-4 turns on Q1308 which in turn lights DS1308 to indicate that subfleet 9 is selected. The high at U1307-4 clocks polled data flip-flops U1304A and U1304B.

3.3 POLLED DATA FLIP-FLOP

The low to high transition from U1307-4 (described above) causes the Q output of D flip-flop U1304A to go high. This high causes the $\overline{Q}$ output of U1304B to go low pulling the $\overline{\text{POLLED DATA}}$ line low through CR1305 which is routed to the UART in the control head. The UART transfers the low $\overline{\text{POLLED DATA}}$ input to the microprocessor informing it that a new subfleet has been selected. This initiates a read action to load the microprocessors RAM with data describing the newly selected subfleet. A high reset pulse from U1302F-13 resets the flip-flops causing the $\overline{\text{POLLED DATA}}$ bit to go high completing the read cycle.

Counter U1306B is used in certain special product applications. However, because JU1 grounds the reset line of U1306B, this circuit is not used in this application.

3.4 1 OF 4 RECEIVE DECODER

The 1 of 4 receive decoder U1305A and U1305B are addressed by receive data lines RD7 through RD3 from the UART. When a hexadecimal 28 is decoded, U1305B-11 goes low to enable the nine bus output three-state buffers. U1301A through U1301D pass the subfleet select data to the UART. U1302A and U1302B provide a ground (low) to the UART to prevent bits TD4 and TD5 from floating. U1302C and U1302D yield no pertinent information in this function.

3.5 POWER UP CIRCUITRY

U1303D and U1303C are Schmitt NAND gates that initialize the selection of a predetermined subfleet upon power up. A gray jumper wire is connected to the board on one end and is terminated by a receptable contact on the other end. The receptacle contact can be connected to any one of eight bubble head pins on the board. For example, if the gray jumper is connected to bubble head pin 1-9 on the lower subfleet board, subfleet 9 is selected upon power up as follows.

On power up, U1303D-12 is connected to bubble head pin 1-9 and goes low to match the initial level of U1307-4. U1303D-11 goes high and produces a high at U1303C-9. U1303C-8 goes high as C1304 charges up through R1302. This produces a low at U1303C-10 which is transferred through CR1302 to turn on U1306A through U1301F. U1306A counts down until U1307-5 goes high to turn off U1306A, turn on polled data flip-flop U1304A and U1304B, and illuminate DS1308 (explained in detail in paragraphs 3.2 and 3.3).

3.6 +5 V REGULATOR

The +5 V regulator Q10 and its associated circuitry convert +12 V switched A+ to regulated +5 V for distribution on the circuit board.

4. JUMPERS ON THE 15 SUBFLEET BOARDS

There are 16 jumper wires labeled B1 to B8 and A9 to AF. The letter B represents the upper board of the 15 subfleet configuration, the letter A represents the lower board. The numbers designate the corresponding subfleet. Thus, the upper board will have B1 through B8 jumpers in and A9 through AF out. The lower board will have B1 through B8 out and A9 through AF in. The seven subfleet board will have jumpers B1 through B7 and AF in and A9 through A15 out.

The 15 subfleet boards can be converted to a seven subfleet operation by removing the upper board and changing the jumpers to the seven subfleet configuration.

5. PUSHBUTTON STOPS

Each 7/15 subfleet select option is shipped with four pushbutton stops. These stops may be used to prohibit the use of any four pushbuttons. To install the stops:

Step 1. Disconnect the cabling from the rear of the unit.

Step 2. Remove the back cover.

Step 3. Remove the circuit boards to gain access to the pushbuttons.

Step 4. Pull off the desired pushbutton covers.

Step 5. Insert pushbutton stops over pushbutton shafts.

Step 6. Re-install pushbutton covers.

Step 7. Reassemble unit.

6. TROUBLESHOOTING PROCEDURE

Troubleshooting chart EEPS-31171 is an aid in troubleshooting the 15 subfleet board.

7. FIELD INSTALLATION

There are two options to adapt a Trunked SYNTOR X mobile radio to 7 or 15 subfleet operation in the field. The TLN2338A 15 subfleet option contains the 15 subfleet options, W306AA, and the code plug kit, TRN4263A. The TLN2339A seven subfleet option contains the seven subfleet option, W307AA, and the code plug kit, TRN4263A. The field installation procedure is the same for both options.

7.1 CONNECTIONS INSIDE MOBILE CONTROL HEAD

The mobile control head must be modified to accommodate the TRN4467A Interface Board which is included in the 7/15 subfleet option, W306AA or W307AA.

NOTE

If the control head already has a multiple system select board TRN4573A, part of option W305A( ), the interface board is not needed. In this case, the TRN4573A provides the necessary interface board connector. The following procedure is still valid if the multiple system select board TRN4573A is substituted for the interface board TRN4467A.

The new TRN4263A code plug must be substituted for this original code plug. To accomplish these modifications, proceed as follows:

Step 1. Remove cable assembly from rear of control head housing.

Step 2. Remove back cover loosening two screws.

Step 3. (Refer to Figure 3.) Remove control head control board. (Also, remove multiple system select board TRN4573A, if used.)

Step 4. Substitute the new code plug for the original one.

Step 5. Wrap the 14 and 16 pin ribbon cables and connectors around the interface board cutout and plug into control board noting arrows on plugs pointing at pin 1.

Step 6. Insert the two boards into the control head housing.

Step 7. Replace back cover and plug in radio cable.

7.2 EXTERNAL CONNECTIONS BETWEEN 7/15 SUBFLEET BOARD AND INTERFACE BOARD.

The TKN8156A Cable Assembly connects between the tan connectors on both boards. (Refer to Figure 2.)

7.3 PUSHBUTTON STOPS

Each 7/15 subfleet select option is shipped with four pushbutton stops. Refer to paragraph 5 for further information.

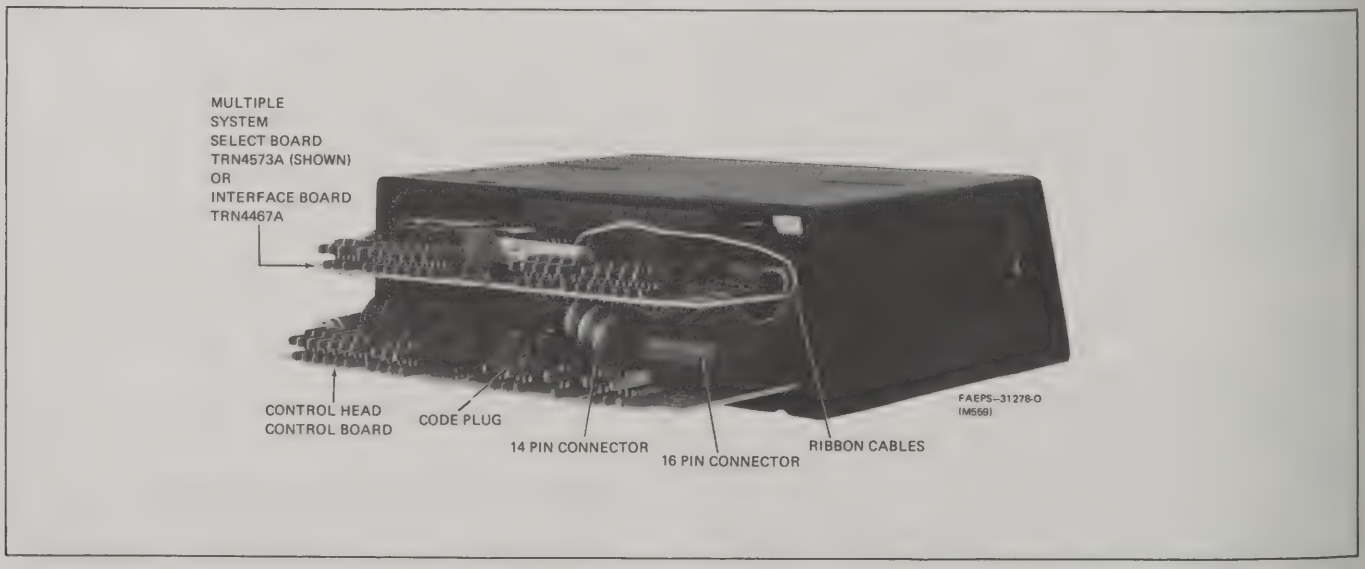
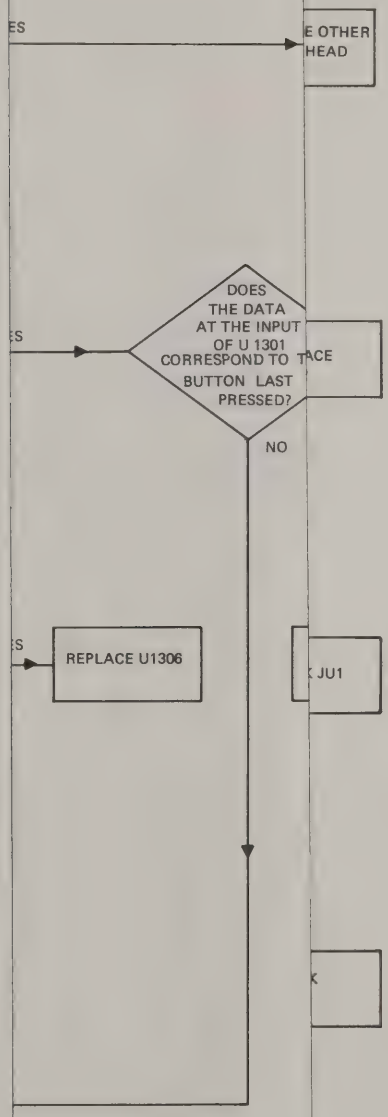


Figure 3. Trunked SYNTOR X 7/15 Subfleet Select Connections to Interface Board (Multiple System Select Board Shown)



Trunked SYNTOR X Subfleet Select Option
Troubleshooting Chart
Motorola No. EEPS-31171-O
11/20/80-PHI

7. FIELD INSTALLATION

There are two options to adapt a Trunked SYNTOR X mobile radio to 7 or 15 subfleet operation in the field. The TLN2338A 15 subfleet option contains the 15 subfleet options, W306AA, and the code plug kit, TRN4263A. The TLN2339A seven subfleet option contains the seven subfleet option, W307AA, and the code plug kit, TRN4263A. The field installation procedure is the same for both options.

7.1 CONNECTIONS INSIDE MOBILE CONTROL HEAD

The mobile control head must be modified to accommodate the TRN4467A Interface Board which is included in the 7/15 subfleet option, W306AA or W307AA.

NOTE

If the control head already has a multiple system select board TRN4573A, part of option W305A( ), the interface board is not needed. In this case, the TRN4573A provides the necessary interface board connector. The following procedure is still valid if the multiple system select board TRN4573A is substituted for the interface board TRN4467A.

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Step 2. Remove back cover loosening two screws.

Step 3. (Refer to Figure 3.) Remove control head control board. (Also, remove multiple system select board TRN4573A, if used.)

Step 4. Substitute the new code plug for the original one.

Step 5. Wrap the 14 and 16 pin ribbon cables and connectors around the interface board cutout and plug into control board noting arrows on plugs pointing at pin 1.

Step 6. Insert the two boards into the control head housing.

Step 7. Replace back cover and plug in radio cable.

7.2 EXTERNAL CONNECTIONS BETWEEN 7/15 SUBFLEET BOARD AND INTERFACE BOARD.

The TKN8156A Cable Assembly connects between the tan connectors on both boards. (Refer to Figure 2.)

7.3 PUSHBUTTON STOPS

Each 7/15 subfleet select option is shipped with four pushbutton stops. Refer to paragraph 5 for further information.

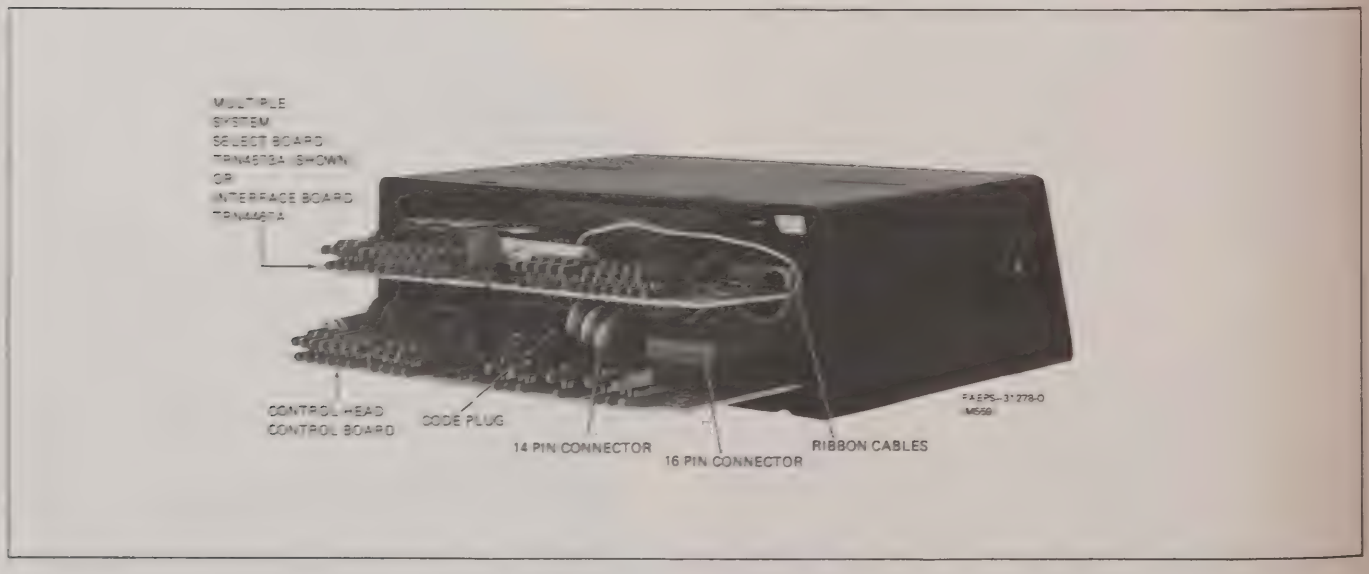
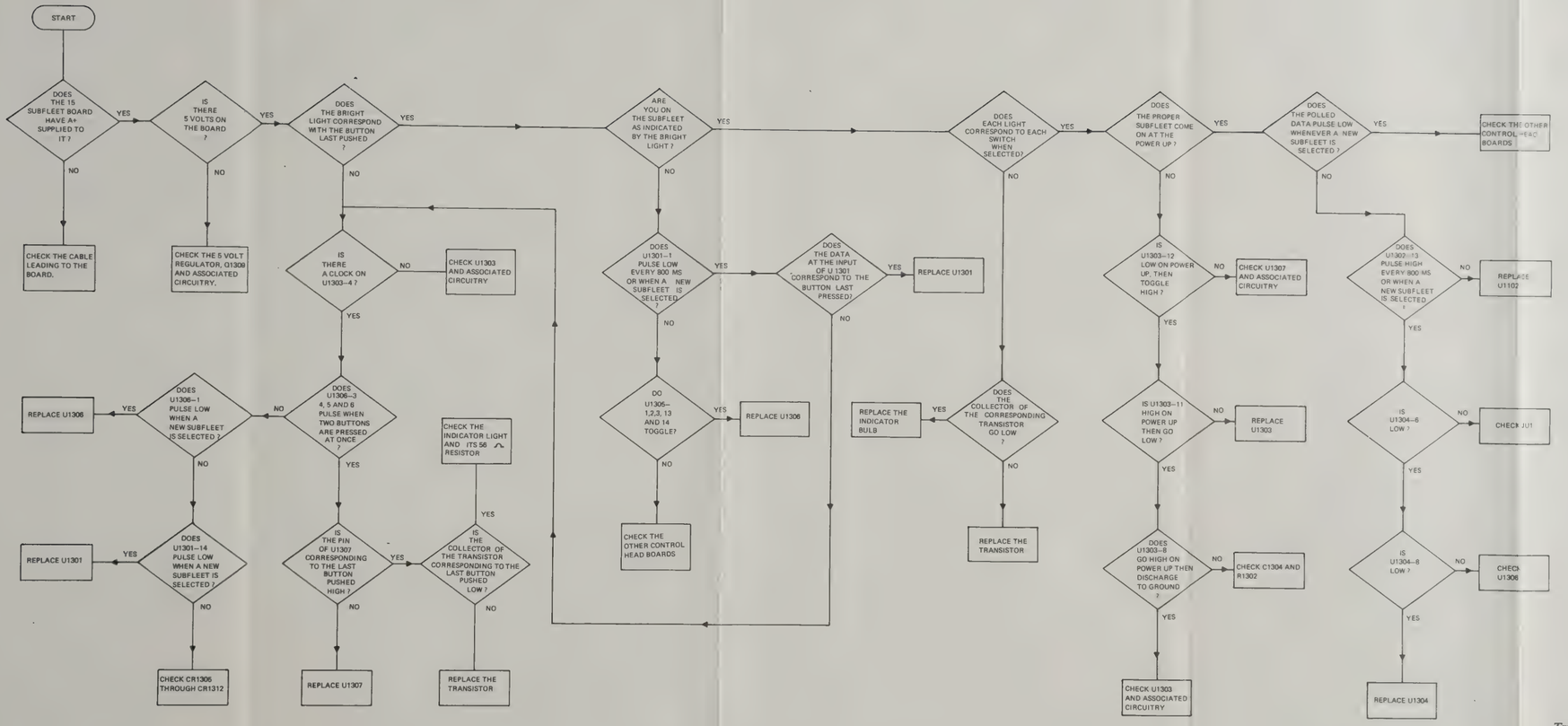


Figure 3. Trunked SYNTOR X 7/15 Subfleet Select Connections to Interface Board (Multiple System Select Board Shown)



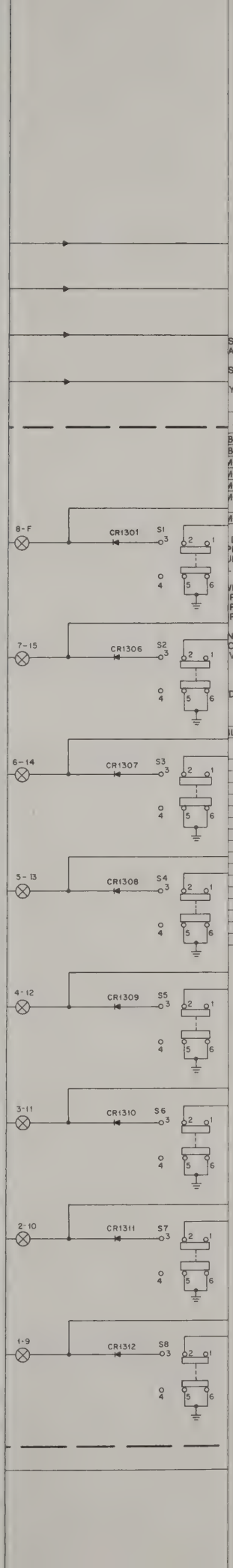
EEPS-31171-O

Trunked SYNTOR X Subfleet Select Option
Troubleshooting Chart
*Motorola No. **EEPS-31171-O***
11/20/80-PHI

wer Board
per Board
rd PL-7163-A

OROLA RT NO.	DESCRIPTION
	capacitor, fixed:
10A08	100 uF +150-10%; 25 V (TRN4460A, 4462A)
26B04	1000 pF ±5%; 100 V (TRN4460, 4462A)
72C01	0.1 uF +80-20%; 25 V (TRN4460, 4462A)
38G01	1.0 uF ±20%; 35 V (TRN4460, 4462A)
15A07	.01 uF +80-20%; 25 V (TRN4460A, 4462A)
	diode: (see note)
54H01	silicon (TRN4460A, 4462A)
54H01	silicon
	lamp, assembly
47E01	clear; 10 V
	connector, receptacle:
39C01	male, long; 10 used
39C02	male, short; 10 used
	connector, plug:
4E05	female; 14 contact (TRN4460A)
3776M01	cable flat w/connector (TRN4461A)
	transistor: (see note)
706	NPN; type M9706
31L76	voltage regulator; 5 V
	resistor, fixed: ±5%, 1/4 W unless otherwise stated
9E73	10k (TRN4460A, 4462A)
9F06	220k (TRN4460A, 4462A)
9E85	33k (TRN4460A, 4462A)
9E73	10k (TRN4460A, 4462A)
9E09	22 (TRN4460A, 4462A)
19	150; 1/2 W
29	150; 1/2 W (TRN4462A only)
9E97	100k
9E85	33k (TRN4460A, 4462A)
	switch:
79B18	dpdt, momentary
	integrated circuit: (see note)
31L96	type M80C97B
34L66	type MC14093
34L13	type MC14013
34L69	type MC14556
34L07	type MC14520
34L32	type MC14514
	mechanical parts
30C01	INSULATOR, switch (8 used)
1B03	CONTACT, pin (8 used)

ormance replacement diodes, transistors, and integrated
y Motorola part numbers.



SE INDICATED: RESISTOR VALUES ARE IN OHMS
ALUES ARE IN MICROFARADS.

SED ONLY ON KIT TRN4462A.

Y ON KIT TRN4460A AND KIT TRN4461A.

TYPE	VCC (+5 V)	GND	MFGR'S DESCRIPTION
80C97B	16	8	TRISTATE BUFFER
80C97B	16	8	TRISTATE BUFFER
MC14093	14	7	QUAD SCHMITT NAND
MC14013	14	7	DUAL D FLIP-FLOP
MC14556	16	8	DUAL 1 OF 4 DECODER
MC14520	16	8	DUAL BINARY UP COUNTER
MC14514	24	12	4 OF 16 DECODER

DASHED LINES IS THE CIRCUITRY FOR TRN4461A
PPER BOARD) WHICH IS ALSO COMMON TO
UBFLEET LOWER BOARD) AND TRN4462A (7
.

WIRES ARE USED AS FOLLOWS:
RU B8 OUT. A9 THRU AF IN.
RU AF OUT. B1 THRU B8 IN.
RU B7 AND AF IN. A9 THRU A15 OUT.

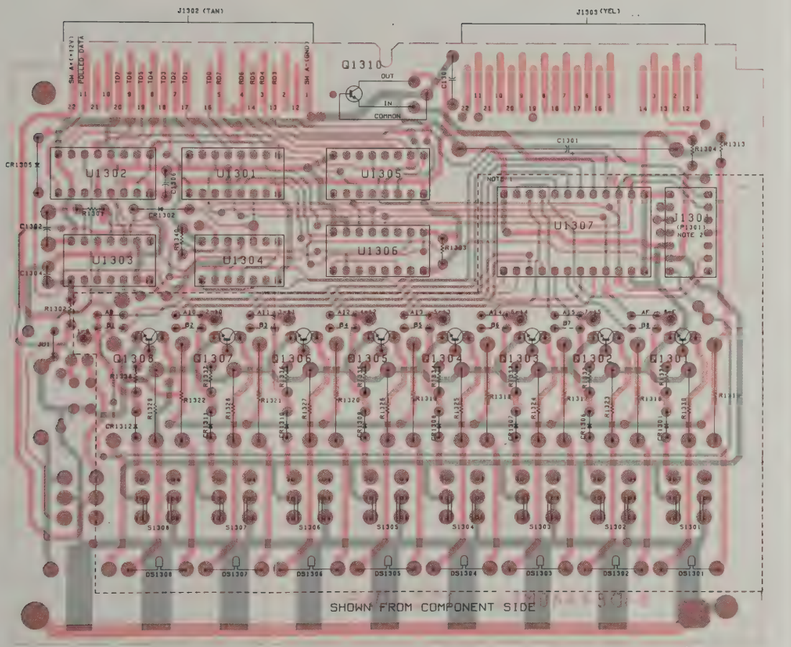
NCE:
OLTS
VOLT

D PIN

LE (U1307)

S	SUBFLEET SELECTED
S0	FLEET
S1	S.F. 15
S2	S.F. 14
S3	S.F. 13
S4	S.F. 12
S5	S.F. 11
S6	S.F. 10
S7	S.F. 9
S8	S.F. 8
S9	S.F. 7
S10	S.F. 6
S11	S.F. 5
S12	S.F. 4
S13	S.F. 3
S14	S.F. 2
S15	S.F. 1

Trunked SYNTOR X Subfleet Select Option
Schematic Diagram
*Motorola No. **PEPS-31223-A***
(Sheet 2 of 2)
1/15/81-PHI



NOTES

1. THE CIRCUITRY ENCLOSED IN THE DASHED LINES IS BASICALLY COMMON TO TRN4460A (TI SUBFLEET LOWER BOARD) AND TRN4462A (T SUBFLEET BOARD). IT IS THE COMPLETE CIRCUITRY OF TRN4461A (TI SUBFLEET UPPER BOARD)
2. P1301 IS USED ONLY ON TRN4460A AND TRN4462A.
3. R1323 THROUGH R1330 ARE USED ONLY ON TRN4462A.
4. A AND B JUMPER WIRES ARE USED AS FOLLOWS
   TRN4460A: B1 THROUGH B8 OUT; A2 THROUGH A7 IN
   TRN4461A: A2 THROUGH A7 OUT; B1 THROUGH B8 IN
   TRN4462A: B1 THROUGH B7 AND A7 IN; A2 THROUGH A15 OUT

COMPONENT SIDE — 0EPS-31222-0
SOLDER SIDE — 0EPS-31221-0
GL — 0EPS-31218-0

parts list

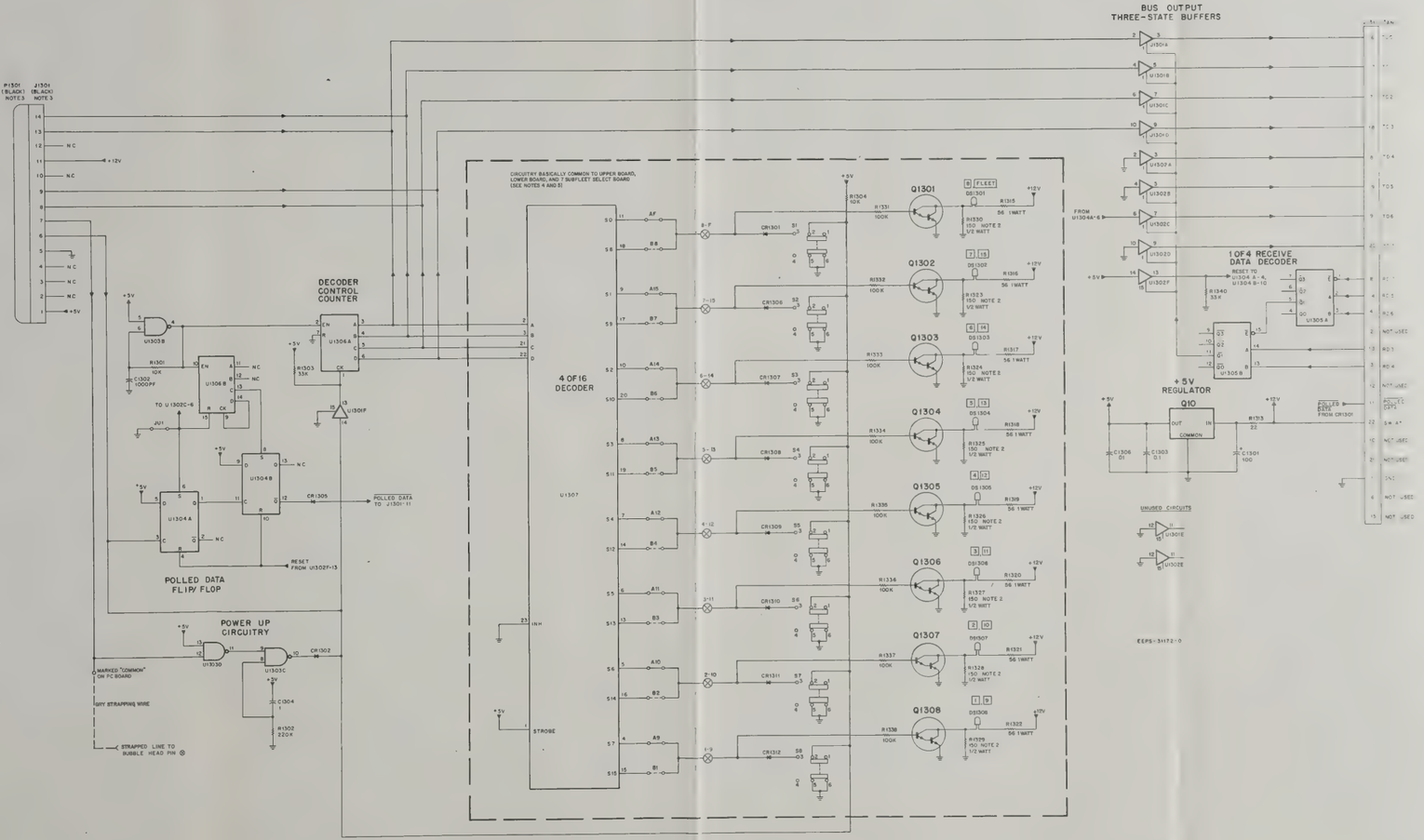
TRN4460A 15 Subfleet Lower Board
TRN4461A 15 Subfleet Upper Board
TRN4462A 7 Subfleet Board

PL-7163-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1301	23-83210A06	100 uF + 150-10%; 25 V (TRN4460A, 4462A)
C1302	21-84426B04	1000 pF ± 5%; 100 V (TRN4460, 4462A)
C1303	21-82372C01	0.1 uF + 80-20%; 25 V (TRN4460, 4462A)
C1304	23-84536Q01	1.0 uF ± 20%; 35 V (TRN4460, 4462A)
C1306	21-11015A07	.01 uF + 80-20%; 25 V (TRN4460A, 4462A)
		diode: (see note)
CR1301, 1302	48-83854H01	silicon (TRN4460A, 4462A)
CR1305 thru 1312	48-83854H01	silicon
		lamp, assembly
DS1301 thru 1308	65-84047E01	clear; 10 V
		connector, receptacle:
J1302	28-84269C01	male, long; 10 used
	28-84269C02	male, short; 10 used
		connector, plug:
P1301	9-84924E05	female; 14 contact (TRN4460A)
	or 30-83776M01	cable flat w/connector (TRN4461A)
		transistor: (see note)
Q1301 thru 1308	48-869706	NPN; type M9706
Q1310	51-84561L76	voltage regulator; 5 V
		resistor, fixed: ± 5%, 1/4 W unless otherwise stated
R1301	6-11009E73	10k (TRN4460A, 4462A)
R1302	6-11009F06	220k (TRN4460A, 4462A)
R1303	6-11009E85	33k (TRN4460A, 4462A)
R1304	6-11009E73	10k (TRN4460A, 4462A)
R1313	6-11009E09	22 (TRN4460A, 4462A)
R1315 thru 1322	6-126A19	150; 1/2 W
R1323 thru 1330	6-125A09	150; 1/2 W (TRN4462A only)
R1331 thru 1338	6-11009E97	100k
R1340	6-11009E85	33k (TRN4460A, 4462A)
		switch:
S1301 thru 1308	40-84979B18	dpdt, momentary
		integrated circuit: (see note)
U1301, 1302	51-84561L98	type M80C97B
U1303	51-82884L66	type MC14093
U1304	51-82884L13	type MC14013
U1305	51-82884L89	type MC14556
U1306	51-82884L07	type MC14520
U1307	51-82884L32	type MC14514
		mechanical parts
	14-84390C01	INSULATOR, switch (8 used)
	9-84151B03	CONTACT, pin (8 used)

note: For optimum performance replacement diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

Trunked SYNTOR X Subfleet Select Option
Circuit Board Detail and Parts List
Motorola No. ***PEPS-31223-A***
(Sheet 1 of 2)
1/15/81-PHI



NOTES

1. UNLESS OTHERWISE INDICATED, RESISTOR VALUES ARE IN OHMS AND CAPACITOR VALUES ARE IN MICROFARADS
2. R1323-R1330 ARE USED ONLY ON KIT TRN4482A
3. P1301 IS USED ONLY ON KIT TRN4480A AND KIT TRN4481A
4. ENCLOSED IN THE DASHED LINES IS THE CIRCUITRY FOR TRN4481A (1/5 SUBFLEET UPPER BOARD) WHICH IS ALSO COMMON TO TRN4480A (1/5 SUBFLEET LOWER BOARD) AND TRN4482A (7 SUBFLEET BOARD)
5. A AND B JUMPER WIRES ARE USED AS FOLLOWS:
   TRN4480A: B1 THRU B6 OUT, A8 THRU AF IN
   TRN4481A: A8 THRU A7 OUT, B1 THRU B6 IN
   TRN4482A: B1 THRU B7 AND AF IN, A8 THRU A15 OUT
6. FOR TEXT REFERENCE:
   LOGIC '1' = 5 V
   LOGIC '0' = 0 V

REFERENCE DESIGNATION		VCC	GND	MFGR'S DESCRIPTION
U1301	74LS	16	8	TRISTATE BUFFER
U1302	74LS	16	8	TRISTATE BUFFER
U1303	74	14	7	QUAD SCHMITT NAND
U1304	74	14	7	DUAL D FLIP-FLOP
U1305	74	16	8	DUAL 1 OF 4 DECODER
U1306	74	16	8	DUAL BINARY UP COUNTER
U1307	74	24	12	4 OF 16 DECODER

LEGEND:

(X) = BUBBLE HEAD PIN

TRUTH TABLE U1307				
A	B	C	D	SUBFLEET SELECTED
0	0	0	0	5A FLEET
1	0	0	0	5B SF 1A
0	1	0	0	5C SF 14
1	1	0	0	6A SF 13
0	0	1	0	6B SF 12
1	0	1	0	6C SF 11
0	1	1	0	7A SF 10
1	1	1	0	7B SF 9
0	0	0	1	7C SF 8
1	0	0	1	8A SF 7
0	1	0	1	8B SF 6
1	1	0	1	8C SF 5
0	0	1	1	9A SF 4
1	0	1	1	9B SF 3
0	1	1	1	9C SF 2
1	1	1	1	10A SF 1

Trunked SYNTOR X Subfleet Select Option
Schematic Diagram
Motorola No. ***PEPS-31223-A***
(Sheet 2 of 2)
1/15/81-PHI

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AVAILABLE BACKGROUND REFERENCE PUBLICATIONS

Five reference publications are available to provide background information needed to service some of the newer Motorola products more effectively. The information in these publications is not duplicated in our instruction manuals. To obtain your free copy, check the ones you want and return this self-mailer to us. (NOTE: One copy of each publication has already been distributed to Motorola Service Shops (MSS's) and field technical representatives (FTR's).

Check item desired:

☐ **Basic Logic Circuit Guide** 68P81105E88
Describes the basic logic circuits used in Motorola Communications digital equipment and the logic notational scheme used in our instruction manuals.

☐ **"Digital Private-Line" Binary-Coded Squelch** 68P81106E83
Contains fundamentals of "Digital Private-Line" system operation, circuit operation and servicing techniques.

☐ **Safe Handling of CMOS Integrated Circuit Devices** 68P81106E84
Describes special handling techniques needed to prevent irrepairable damage from static charges encountered with normal handling of CMOS devices.

☐ **Reducing Noise Interference in Mobile Two- Way Radio Installations** 68P81109E33
Defines the major sources of noise encountered in a mobile radio installation and suggests methods of remedying them.

☐ **Anti-Skid Braking Precautions** 68P81109E34
Provides installation suggestions and a detailed checkout procedure for installation of mobile radios in vehicles with anti-skid braking systems.

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USER QUESTIONNAIRE

To the User of This Instruction Manual:

Motorola is engaged in a continuous program of improving its instruction literature. We believe that you can aid us in this program, so that we in turn can better help you service our equipment. To foster these aims, would you please answer the following questions:

SCHEMATIC DIAGRAMS AND CABLING DIAGRAMS

1. ☐ Are accurate and easy to follow
2. ☐ Contain minor errors
3. ☐ Contain major errors
4. ☐ Are difficult to follow

If you have checked any box except 1, please tell us what schematic diagrams, or portions thereof, were at fault, or enter other comments.*

_____

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TEXT

1. ☐ Easy to follow — helps to service equipment
2. ☐ Would like more information on*

_____

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3. ☐ Some instruction sections are too long or superfluous such as*

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TRUNKED SYNTOR X™
FM Two-Way Radio
806-870 MHz
35 Watts

68P81043E50-B

MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

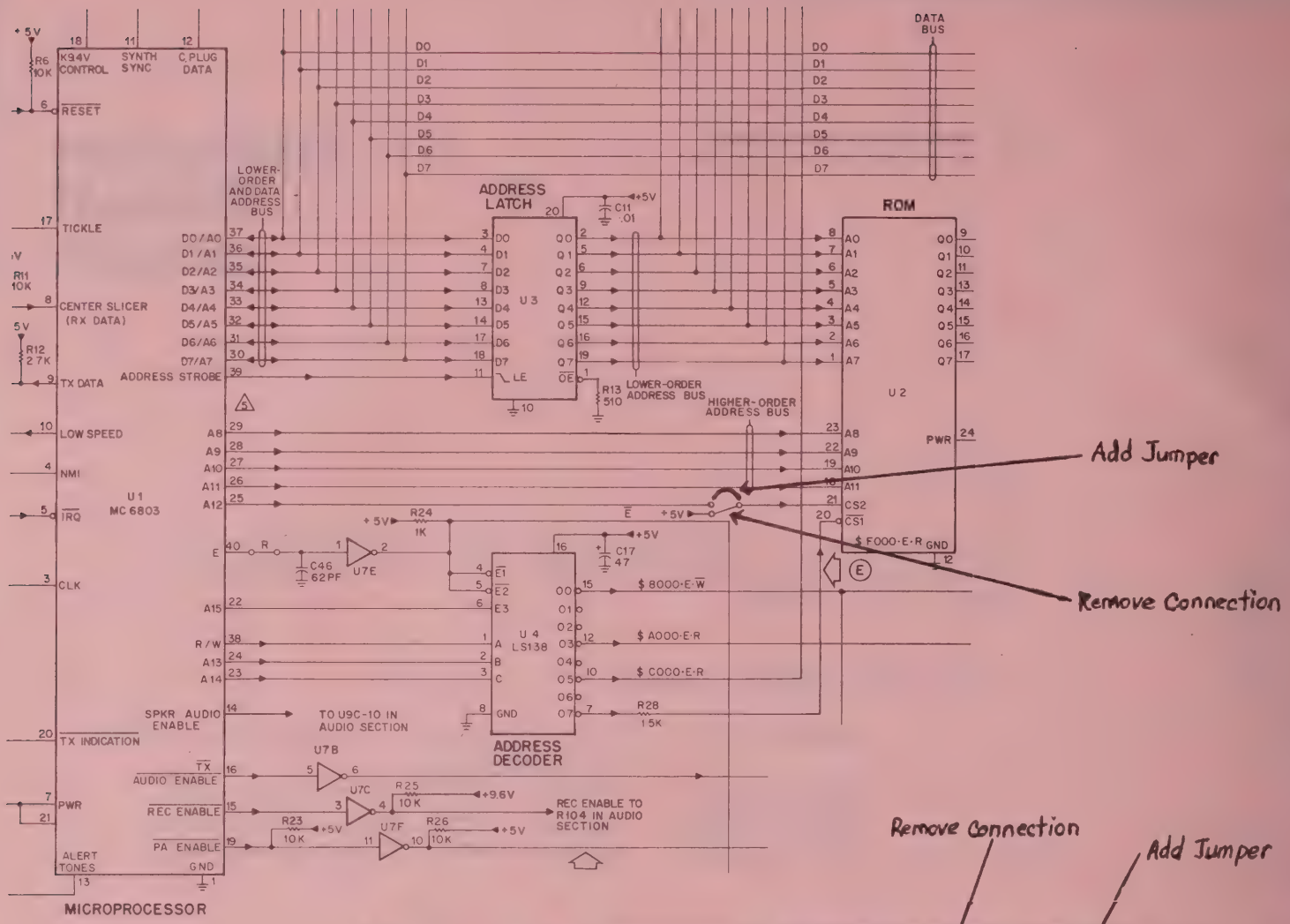
INSTRUCTION MANUALS AFFECTED:

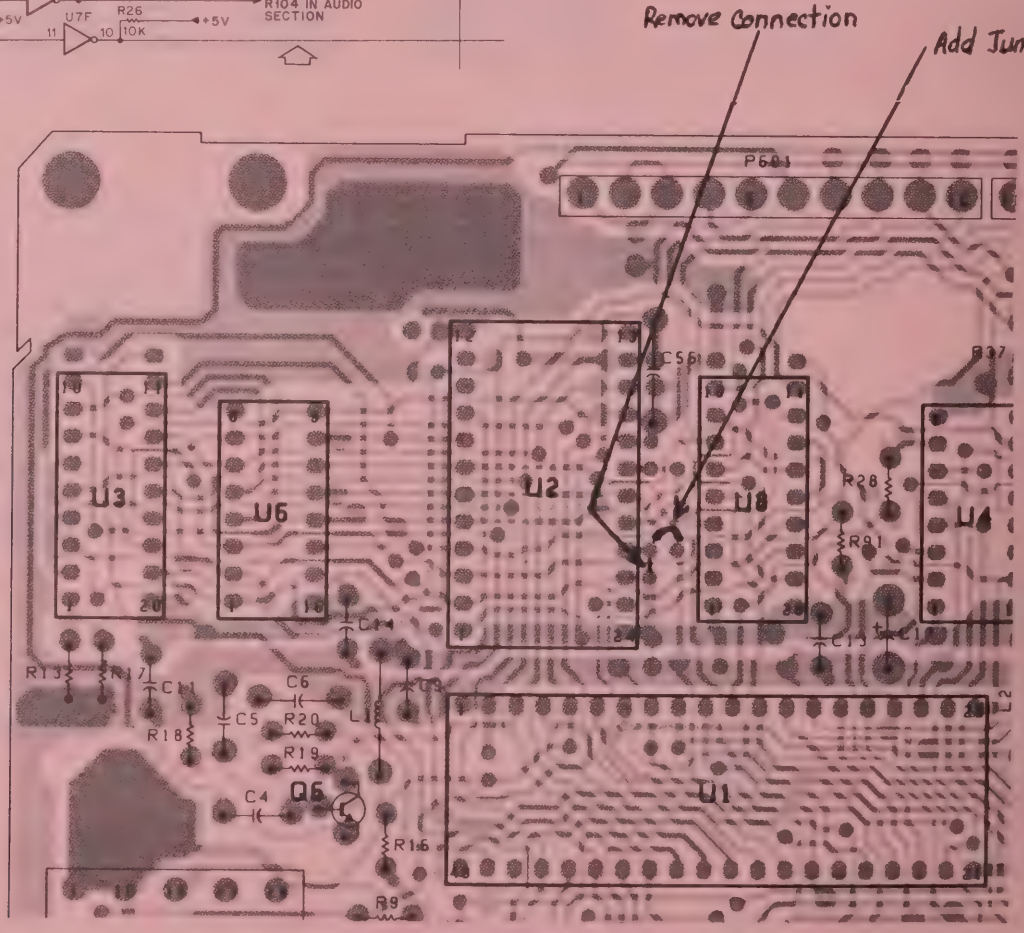
68P81043E55-B	Trunked *SYNTOR X* or *SYNTOR X3* FM Radio Control Station
68P81043E50-B	Trunked *SYNTOR X* FM Two-Way Radio
68P81047E05-O	Trunked *SYNTOR X2* FM Two-Way Radio
68P81060E10-O	Trunked *SYNTOR X3* FM Two-Way Radio

REVISION DETAILS:

To allow 12.5 kHz offset channels in your radio, the standard 4k x 8 byte programmed ROM is replaced with a 8k x 8 byte ROM described below. For the *SYNTOR X2* and *SYNTOR X3* Mobiles only, the Personality Board is modified to accept the 8k x 8 byte part (see attached schematic). All *SYNTOR X2* and *SYNTOR X3* Personality Boards which have been factory jumpered for offset channels have a "B" suffix designation (TRN4719B).

Description	Programmed Part	Kit
Programmed ROM for *SYNTOR X* Mobile, *SYNTOR X2* MOBILE (W/308 option) or, *SYNTOR X* or *SYNTOR X3* Control Station to allow Offset Channels.	51-90008C07	TRN5923A
Programmed ROM for *SYNTOR X3* Mobile or *SYNTOR X2* Mobile (w/o W308 option) to allow Offset Channels.	51-90008C08	TRN5925A





SHOWN FROM SOLDER SIDE

*Trunked **SYNTOR X2** and **SYNTOR X3** Personality Board Schematic Diagram, Circuit Board Detail, Phone Patch or Offset Channel Modification TRN4719B*

MOTOROLA INC.

instruction manual revision

WARNING
This revision contains important safety information.

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUALS AFFECTED:

Service, Owner's, and Operator's manuals for Mobile RF Equipment

REVISION DETAILS:

The following safety notice applies to mobile installations in vehicles fueled by liquefied petroleum (LP) gas. File this manual revision directly under the front cover of the manual.

SAFETY INFORMATION FOR RADIOS INSTALLED IN VEHICLES POWERED BY LIQUEFIED PETROLEUM (LP) GAS

WARNING
It is mandatory that radio installations in vehicles fueled by liquefied petroleum gas conform to the following standard.

National Fire Protection Association standard NFPA 58 applies to radio installations in vehicles fueled by liquefied petroleum (LP) gas with the LP-gas container in the trunk or other sealed-off space within the interior of the vehicles. This standard requires that:

1. Any space containing radio equipment shall be isolated by a seal from the space in which the LP-gas container and its fittings are located.
2. Remote (outside) filling connections shall be used.
3. Venting of the container space to the outside shall be provided.

EPS-33497-O

MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81043E50-O, A, B Trunked SYNTOR X FM Two-Way Radio

REVISION DETAILS:

This revision supersedes instruction section 68P81051E01-A, entitled Trunked SYNTOR X Multiple System Select Option W305AA, AB, AC, AD. A field installation procedure is added to the superseded section. The new section should be substituted for 68P81051E01-A in the OPTIONS AND ACCESSORIES tab.

ATTACHMENTS:

Trunked SYNTOR X Multiple System Select
Option W305AA, AB, AC, AD. 68P81111E41-O

MOTOROLA INC.
Communications Group

TRUNKED *SYNTOR X* MULTIPLE SYSTEM SELECT

OPTION W305AA, W305AB, W305AC, W305AD

1. GENERAL DESCRIPTION

The Trunked *SYNTOR X* Multiple System Select Option W305AA, AB, AC, AD allows an operator to select up to five different trunked systems or fleets. A typical "system" consists of a system central controller and up to 20 trunked repeaters. A "fleet" consists of a set of subfleets which can have several individual users. The multiple system select option permits an operator to access up to five systems or fleets in a local area or in various geographical regions. With the addition of a volume set and/or five subfleet select option, additional capabilities are possible.

Figure 1 shows a trunked control head with the volume set and five subfleet option in addition to the W305AD multiple system select option. With this combination, an operator may select any one of up to five subfleets or five fleet/subfleet combinations in any one of five systems.

The basic Trunked *SYNTOR X* Multiple System Select option consists of a multiple system select board with up to five code plugs and an escutcheon and hardware kit. Three additional option combinations are available. The options table below defines the details of the four options.

The multiple system select board mounts inside the control head housing. The five system select pushbuttons and associated indicator lights mount at the top front of the control head as shown in Figure 1.

A secondary function of the multiple system select board is to act as an interface for a 7 or 15 subfleet select option and a phone patch board option; if applicable. When the phone patch option is used, a telephone line may be accessed via the mobile radio system. When the 7 subfleet or 15 subfleet option is used in conjunction with the five multiple system select option, an operator may select seven subfleets plus one fleet or 15 subfleets and one fleet in each of the five systems. The 7 or 15 subfleet option is described in detail in section 68P81111E19-O of Trunked *SYNTOR X* FM Two-Way Radio service manual 68P81043E50.

2. OPERATING PROCEDURE

(Refer to Figure 1.)

Any one of up to five systems or fleets can be selected by depressing the desired system select pushbutton. The associated indicator light illuminates at high intensity. If no pushbutton is depressed, system

Options Table for Trunked SYNTOR X Mobile Radio

Option	Add	Delete	Applicability	Remarks
W305AA	TLN2319A* TRN4569A	TRN4264A	All single subfleet units w/o volume set	Provides selection of up to five different systems or fleets.
W305AB	TLN2319A* TRN4570A	TRN4265A	All single subfleet units with volume set	Provides selection of up to five different systems or fleets with the volume set option.
W305AC	TLN2319A* TRN4571A	TRN4266A	All five subfleet units w/o volume set	Provides selection of up to five different systems or fleets with the five subfleet select option.
W305AD	TLN2319A* TRN4572A	TRN4267A	All five subfleet units with volume set	Provides selection of up to five different systems or fleets with the five subfleet select and volume set options.

*TLN2319A consists of (1) Multiple System Select Board TRN4573A, (2) Spare Button and Button Stop Kit TRN4273A, and (3) Code Plug TRN4263A.

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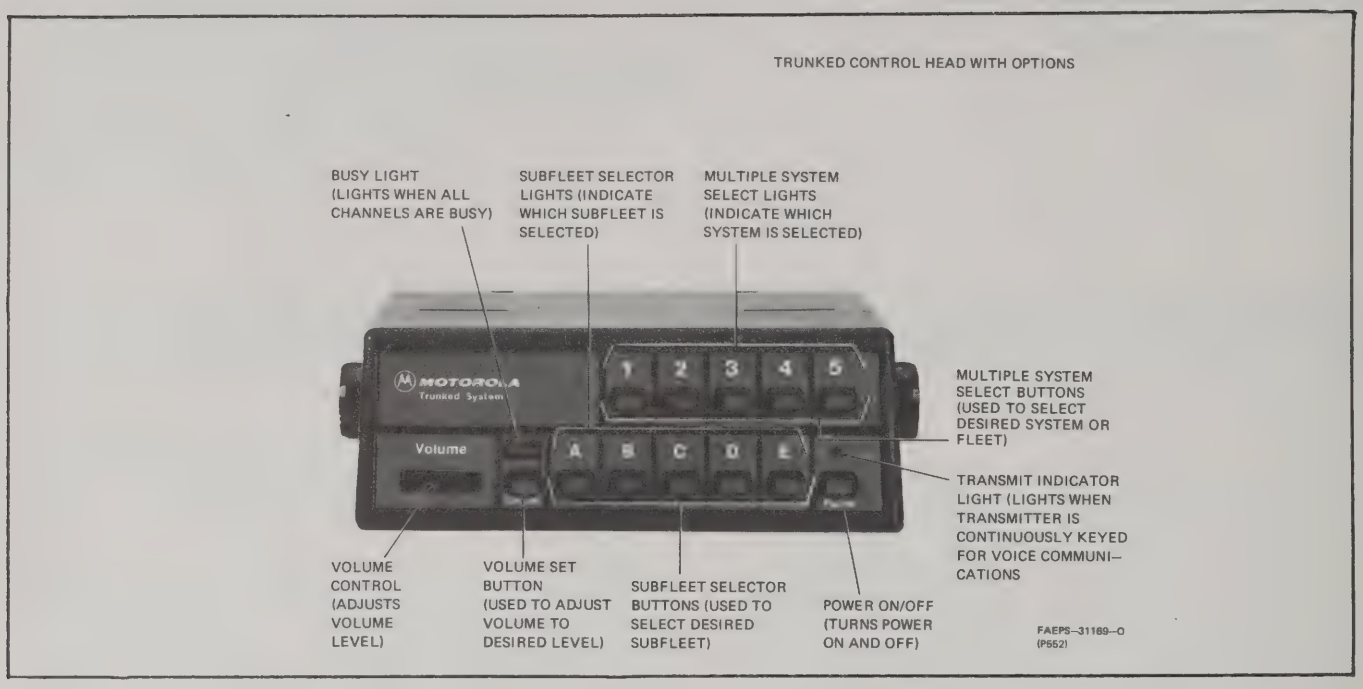


*Figure 1. Trunked **SYNTOR X** Control Head with Multiple System Select Option W305AD and Five Subfleet Select and Volume Set Options*

one is selected. There is a wait of approximately one second before the mobile can receive and transmit calls after a system selection is made.

Once the system is selected, the subfleet selector pushbuttons may be depressed to access the individual subfleet or fleet desired in the system.

3. THEORY OF OPERATION

(Refer to schematic diagram EEPS-31066)

3.1 CODE PLUG CIRCUITRY

All five code plugs are connected to both the transmit data bus and the receive data bus. The receive data bus is composed of bits RD0 through RD4 which are used for code plug addresses A0 through A4. The five address lines permit the addressing of the entire 32 bytes of the code plug (PROM). The transmit data bus transfers the 8-bit words to the UART (Universal Asynchronous Receiver Transmitter), located on the control board where they are serialized for transmission via the serial link to the microprocessor on the trunked personality board in the radio.

Only one code plug is enabled on the transmit data bus at any one time to prevent bus contention. This is achieved through the use of an interlocked switch (S1201) where only one button can be depressed at a time.

The $\overline{\text{C.P. SELECT}}$ (Code Plug Read) input from the microprocessor is used to enable the code plug during a read cycle. Operating power for the code plug (V_{CC}) is supplied only when a code plug select command is being executed. Operating power for each code plug is controlled by a three-state buffer, pull-up resistor, and a PNP transistor.

When a system select pushbutton (S1201) is depressed, the input of one of the three-state code plug select buffers is grounded; for example, U1203A-2. When the $\overline{\text{C.P. SELECT}}$ input goes low, all the three-state buffers are enabled, but in this example, only the output of U1203A goes low. The low output at U1203A-3 pulls $\overline{\text{CS}}$ low at U1204-15 and turns on Q1202. Q1202 supplies between +5 V to U1204-16. This action fully enables U1204 allowing it to be addressed and its contents to be transferred to the UART on the control board. The code plug is powered up every 23 ms. After the code plug has been read, the $\overline{\text{C.P. SELECT}}$ line goes high removing the low $\overline{\text{CS}}$ input to the code plug and +5 V from the code plug PWR input.

3.2 SERIAL LINK DRIVER

The contacts of the system select switch S1201 are a break-before-make type. Therefore, when a system select pushbutton is depressed, a high to low logic level transition occurs at the clock input of U1201A and through C1201 to U1202B-5. This action causes the output of U1202B to go high for 0.22 ms which sets flip-flop U1201A. U1201A-2 then goes low which allows U1201B to be toggled by the $\overline{\text{C.P. SELECT}}$ input at U1201B-13 and pulls $\overline{\text{POLLED DATA}}$ low through CR1203. The low $\overline{\text{POLLED DATA}}$ input is routed to the UART in the control head. The UART transfers the low $\overline{\text{POLLED DATA}}$ input to the microprocessor which

initiates a code plug read action to load the microprocessor's RAM with data from the newly selected code plug.

The initial POLLED DATA pulse started by the S1201 switching action could occur anytime during the C.P. SELECT pulse read cycle. To assure a full 23 ms of code plug read time, the microprocessor initiates the first of two C.P. SELECT pulses. The first pulse applied to the clock input of U1201B causes the Q output to toggle high. The second C.P. SELECT pulse at the clock input of U1201B causes the Q output to toggle low which produces a 0.22 ms high at U1202A-3. The high output of U1202A resets U1201A. When U1201A resets, the $\overline{Q}$ output goes high resetting U1201B and allows POLLED DATA pulse to go high to complete a 23 ms read cycle. The entire process is repeated whenever S1201 is operated to select a different system.

3.3 POWER SUPPLY

Q1201 and associated circuitry convert the SW A+ input to a regulated +5 V ouput for application throughout the circuit board.

4. FIELD INSTALLATION PROCEDURE

An existing Trunked *SYNTOR X* radio can be modified in the field to accommodate the multiple system select option. Multiple System Select Field Modification Kit TLN2354A contains the required parts. The installation procedure is as follows:

Step 1. Turn off the power to the radio.

Step 2. Remove the trunked control head from the mounting bracket by first removing the two shoulder screws.

Step 3. Disconnect the microphone, speaker, yellow, and black connectors from the back of the control head.

Step 4. Pry up one end of the top escutcheon from the control head and carefully peel it off.

Step 5. Peel off the backing paper from the escutcheon supplied and press it into place.

Step 6. Loosen the two knurled screws on the bottom of the control head and remove the back cover.

Step 7. Extract the control board from the control head housing.

CAUTION

The control board contains CMOS integrated circuits. Refer to Trunked *SYNTOR X* FM Two-Way Radio instruction manual 68P81043E50 for procedure for safe handling.

Step 8. Plug the 14 pin and 16 pin flat ribbon cable connectors from the Multiple Code Plug Board (see Figure 2) into their respective sockets (J1105 and J1106) on the control head board. Ensure that pin 1 of the connectors mate with pin 1 of the sockets.

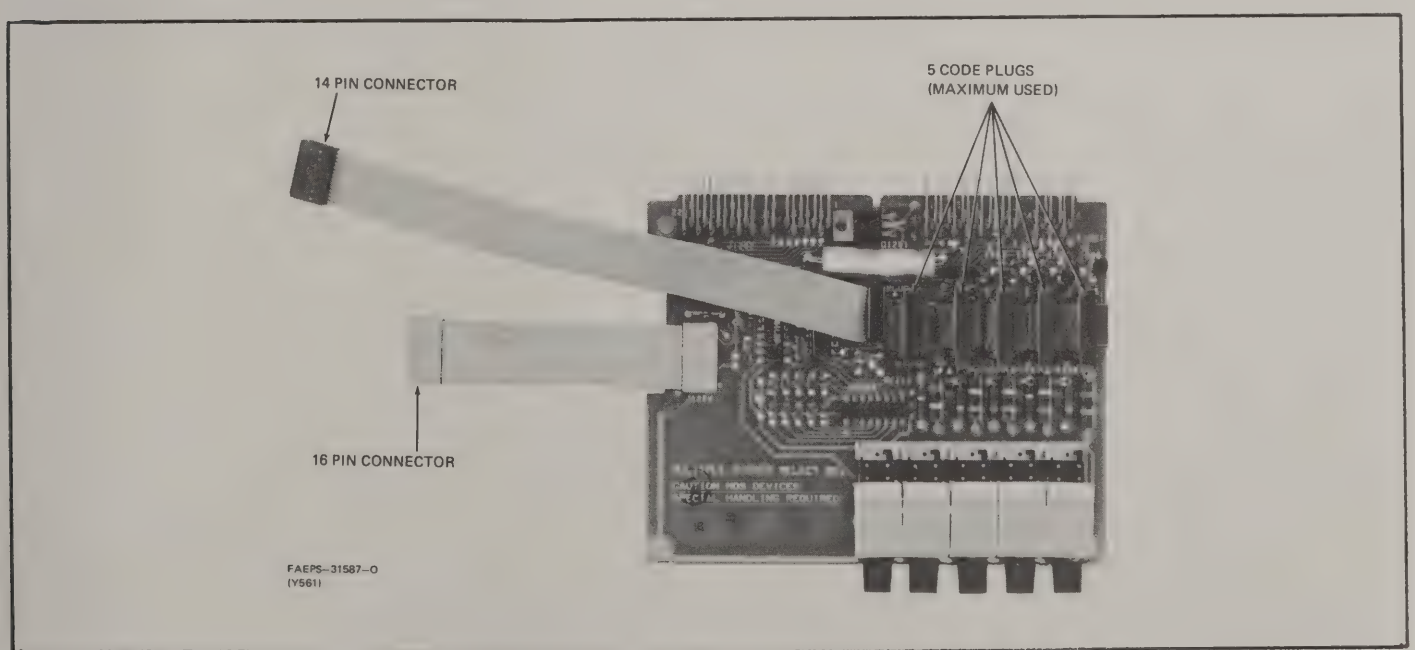


Figure 2. Multiple System (Code Plug) Select Board TRN4573A

Step 9. Secure the connector-socket assemblies with the clips provided.

Step 10. If all five code plug sockets contain a code plug (see Figure 2), no button stops are required. If, however, less than five code plugs are provided, slip a button stop over each pushbutton switch shaft corresponding to a missing code plug.

Step 11. Slip the pushbuttons provided over the pushbutton shafts.

Step 12. Slide the two boards into the housing (control board on the bottom) making sure that the two flat ribbon cables are positioned so that they fit inside the notch in the side of the top board.

Step 13. Reinstall and secure the back cover.

Step 14. Reconnect the microphone, speaker, yellow and black connectors.

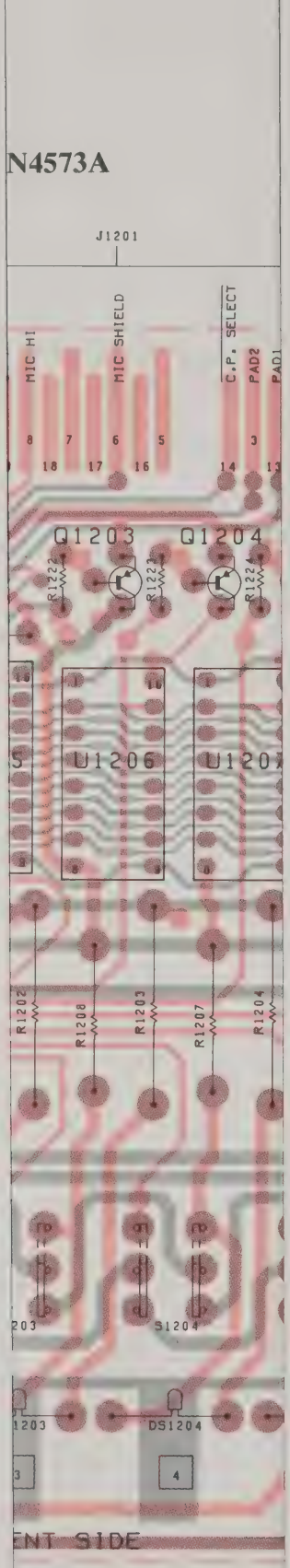
Step 15. Reinstall and secure the control head to its bracket.

The parts list for the TLN2354A Multiple System Select Field Modification Kit follows.

parts list

TLN2354A Multiple System Select Field Modification Kit PL-7269-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	13-83772M06	ESCUTCHEON
	38-80029B03	BUTTON, push (5 used)
	38-84617C01	BUTTON, stop (4 used)
	68-81111E41	INSTRUCTION SHEET
	TRN4464A	CLIPS, 14 and 16 pin connector
	TRN4573A	BOARD, PC (contains up to five preprogrammed code plugs)



*Trunked **SYNTOR X** Multiple System Select*
Option W305AA, AB, AC, AD,
Circuit Board Detail and Parts List
*Motorola No. **PEPS-31149-A***
(Sheet 1 of 2)
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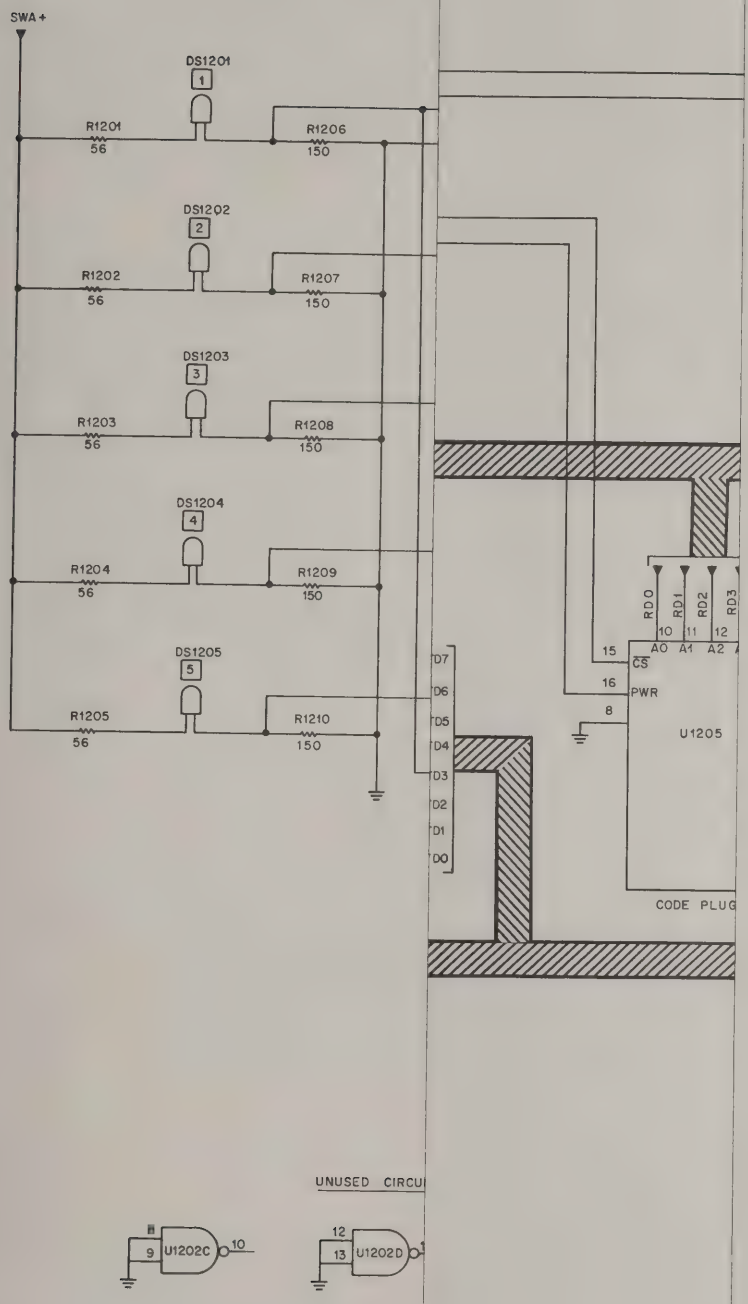

*Trunked **SYNTOR X** Multiple System*
Select Board TRN4573A Schematic Diagram
*Motorola No. **PEPS-31149-A***
(Sheet 2 of 2)
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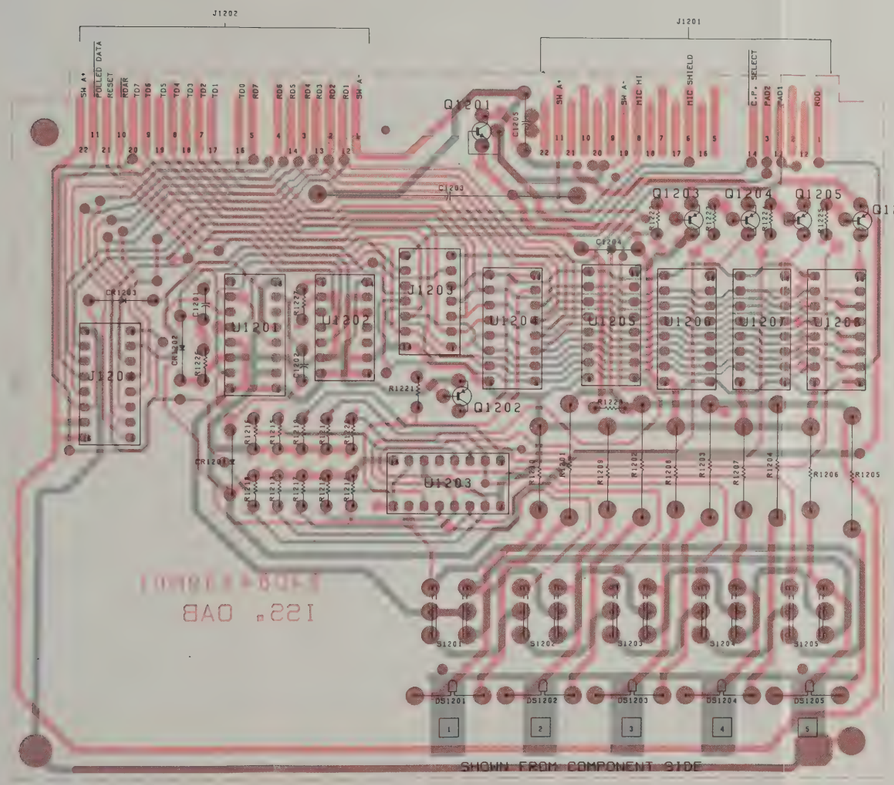
MULTIPLE SYSTEM SELECT BOARD TRN4573A



COMPONENT SIDE 80-DEPS-31148-O
SOLDER SIDE 80-DEPS-31147-O
OL-DEPS-31146-O

*Trunked **SYNTOR X** Multiple System Select*
Option W305AA, AB, AC, AD,
Circuit Board Detail and Parts List
*Motorola No. **PEPS-31149-A***
(Sheet 1 of 2)
1/30/81-PHI

parts list

TRN4573A Multiple System Select Board — PL-7148-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1201, 1202	21-11015A07	.01 uF + 80-20%; 100 V
C1203	23-83210A08	100 uF + 150-10%; 25 V
C1204, 1205	21-82372C01	0.1 uF + 80-20%; 25 V
		diode: (see note)
CR1201, 1202	48-84616A01	silicon (hot carrier)
CR1203	48-83654H01	silicon
		lamp:
DS-1201 thru 1205	65-84047E01	10 V; clear
		connector, receptacle: consists of:
J1201, 1202	28-84269C01	male; low profile; 10 used
	28-84269C02	male; high profile; 10 used
J1203	30-83776M01	flat cable; 14 pin
J1204	30-84799M01	flat cable; 16 pin
		transistor: (see note)
Q1201	51-84561L76	voltage regulator; 5 V
Q1202 thru 1206	48-869649	PNP; type M9649
		resistor, fixed: ± 5%; **1/8 W;** unless otherwise stated:
R1201 thru 1205	6-126A19	56; 1 W
R1206 thru 1210	6-125A29	150; 1/2 W
R1211 thru 1220	6-11009E81	22k
R1221 thru 1225	6-11009E57	2.2k
R1226, 1227	6-11009E81	22k
R1228	6-11009E09	22
		switch:
S1201	40-84324C06	pushbutton; 5 section
		integrated circuit: (see note)
U1201	51-82884L10	type M8410; dual JK flip-flop
U1202	51-82884L66	type M8466; Quad NAND Schmitt Trigger
U1203	51-84561L96	type M6196; three-state buffer
		mechanical parts
	14-84360C01	INSULATOR, switch; 5 used
	9-84924E02	SOCKET, 16 contact; 5 used
	75-82663M02	PAD, foam; 5 used

TRN4263A Code Plug, Trunking — PL-7149-O

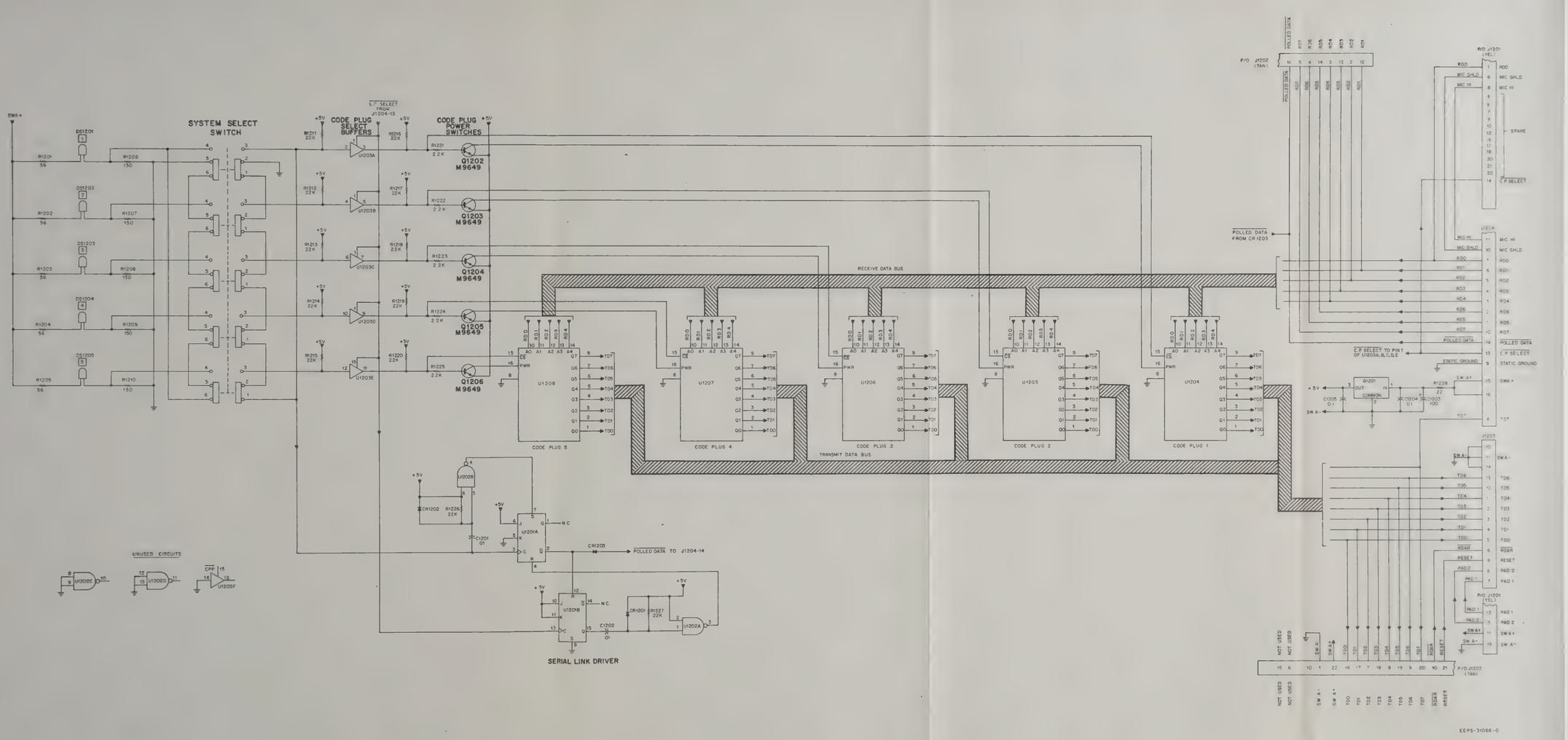
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U1204 thru 1208	51-82848M48	type M4848
		mechanical parts
	42-82660M01	CLIP, 16-contact
	75-82663M02	PAD, foam

TRN4273A Button Spare and Button Stop — PL-7151-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	38-84617C01	BUTTON, stop

TRN4569A Escutcheon and Hardware Basic with Multiple System Select
TRN4570A Escutcheon and Hardware with Volume Set and Multiple System Select
TRN4571A Escutcheon and Hardware Subfleet and Multiple System Select
TRN4572A Escutcheon and Hardware with Subfleet, Volume, and Multiple System Select — PL-7152-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	13-83772M02	ESCUTCHEON; (TRN4569A)
	13-83772M03	ESCUTCHEON (TRN4570A)
	13-83772M04	ESCUTCHEON (TRN4571A)
	13-83772M05	ESCUTCHEON (TRN4572A)
	13-83772M06	ESCUTCHEON (All Models)
	38-80029B02	BUTTON, push (1 used on TRN4569A and TRN4571A) (2 used on TRN4570A and TRN4572A)
	38-80029B03	BUTTON, push (5 used on TRN4569A and TRN4570A) 10 used on TRN4571A and TRN4572A



*Trunked **SYNTOR X** Multiple System Select Board TRN4573A Schematic Diagram Motorola No. **PEPS-31149-A** (Sheet 2 of 2) 1/30/81-PHI*

MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81043E55-B Trunked SYNTOR X FM Radio Control Station, 10 W
68P81043E50-B Trunked SYNTOR X FM Two-Way Radio, 35 W
68P81044E40-A SYNTOR X FM Two-Way Radio, 35 W

REVISION DETAILS:

IMPORTANT

The following information is provided to insure accurate measurement of R.F. power in the 800 MHz frequency spectrum. This information should be inserted as part of the GENERAL MAINTENANCE/TROUBLESHOOTING section of each of the above mentioned instruction manuals, and be performed before doing any transmitter power tests.

MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81043E50-O,A,B Trunked SYNTOR X FM Two Way Radio

REVISION DETAILS:

This revision adds the MICOR Cable Conversion Kit (Option 414AB) instruction section, 68P81110E63 to the manual. Insert this section at the end of the Options and Accessories section.

ATTACHMENTS:

MICOR Cable Conversion Kit (Option W414AB) Instruction Section 68P81110E63-O

MICOR™
CABLE CONVERSION KIT OPTION W414AB

(FOR TRUNKED *SYNTOR X*™ COMPATIBILITY)

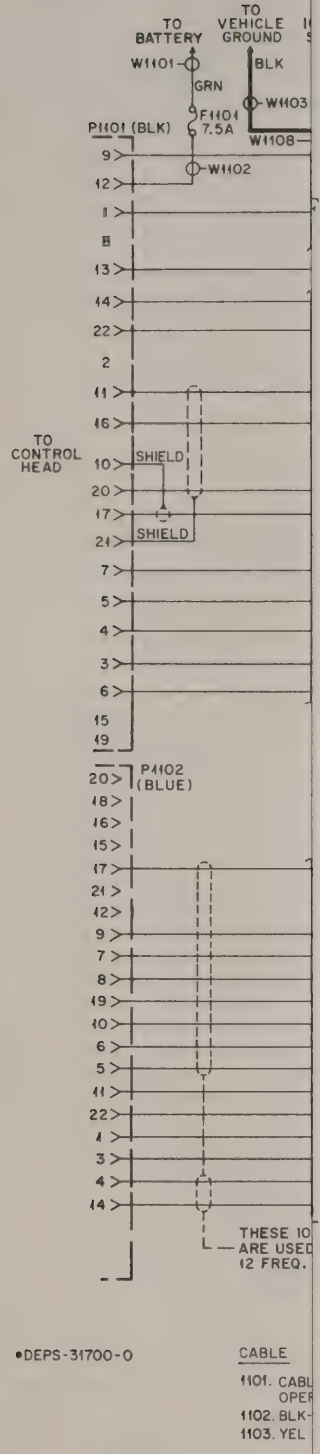


Figure 1. Trunked Micor
Radio W

1. GENERAL DESCRIPTION

An existing trunked *Micor* radio installation can be readily adapted to accept a Trunked *SYNTOR X* radio. Conversion requires a TRN4432A Trunked Control Head Adapter Cable Kit and a TRN4735A Cable Converter Box. Figure 1 shows an existing trunked *Micor* cable wiring diagram.

2. CONVERSION PROCEDURE

Remove the trunked *Micor* radio and control head from the vehicle and proceed as follows.

Step 1. Remove the following wires from the blue connector of the TKN6454B *Micor* Cable Kit (using provided tool, part no. 66-84690C01), and install these wires in the provided yellow connector, part no. 14-84590B06. (Refer to Figure 2.)

Wire Color	Blue Connector (Remove wire)	Yellow Connector (Insert wire)
Gray	Pin 1	Pin 4
Black	Pin 3	Pin 3
Blue	Pin 11	Pin 1
White	Pin 22	Pin 6

Step 2. Tie back the blue connector and remaining wires.

Step 3. Connect the microphone, speaker, yellow, and black connectors into the Trunked *SYNTOR X* control head.

Step 4. Connect the TRN4735A Cable Converter Box to the front of the Trunked *SYNTOR X* radio. Secure with large retention screw on the cable converter box. Figure 3 shows the cable converter box wiring diagram.

Step 5. Connect the modified *Micor* cable to the cable converter box. Secure the cable with the hold down bracket on the cable converter box.

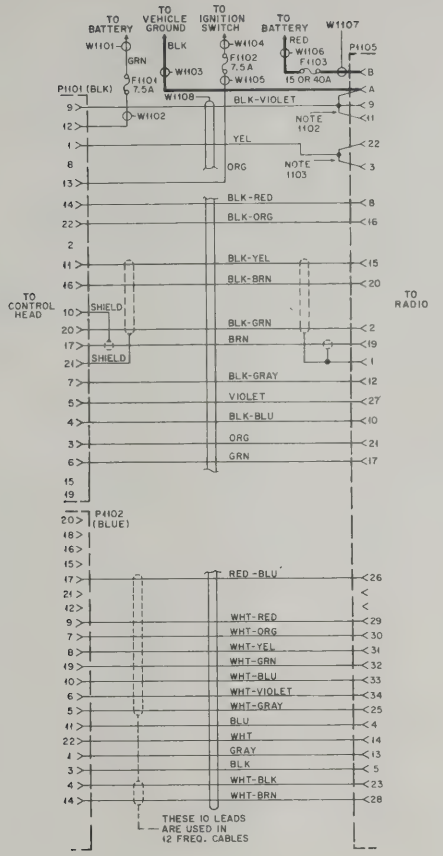
Step 6. Install the Trunked *SYNTOR X* radio and control head into the vehicle.

parts list

TRN4735A Cable Converter Box PL-7271-

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1-80726D27	CIRCUIT BOARD
	3-139999	SCREW, tapping 6-19 x 3/8" (4 used)
	3-140079	SCREW, tapping 6-19 x 1/2" (6 used)
	3-84291M01	SCREW, cable converter
	7-84286M01	BRACKET, hold down
	9-80227B01	CONTACT, female pwr
	9-84151B01	RECEPTACLE, contact
	15-80216B01	CONNECTOR, housing back
	15-84284M01	HOUSING, cable converter
	15-84285M01	COVER, cable converter
	42-80156B01	RING, retainer
	43-84289M01	SPACER
	75-82200H17	PAD, oscillator
	32-83859M01	GASKET, connector

68P81110E63-O
4/17/81-PHI



•DEPS-31700-O

CABLE

1101. CABLE SHOWN CONNECTED FOR NEGATIVE GROUND OPERATION
1102. BLK-VIO JUMPERS JOINED WITH BLU JUNCTION-LUG
1103. YEL JUMPERS JOINED WITH YEL JUNCTION-LUG.

*Figure 1. Trunked **Micor** Cable Kit with Trunked **Micor** Radio Wiring Diagram*

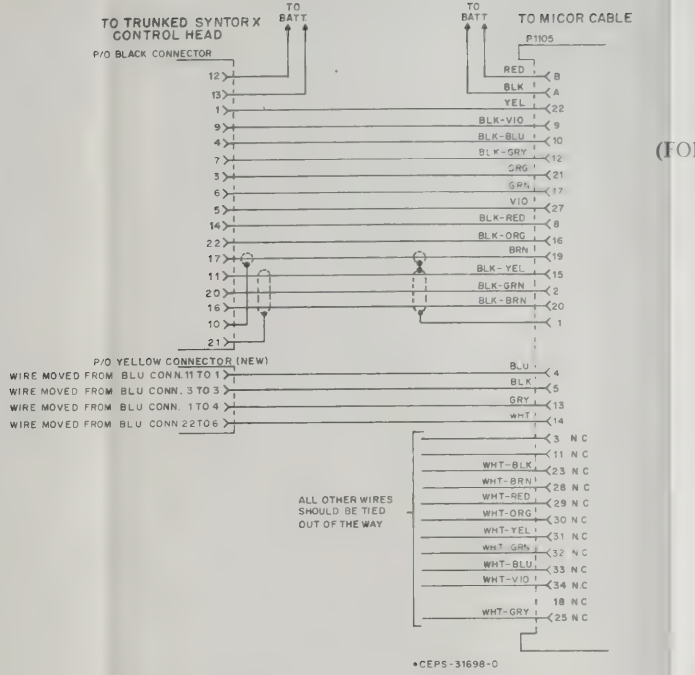
parts list

TRN4735A Cable Converter Box — PL-7271-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1-80726D27	CIRCUIT BOARD
	3-139999	SCREW, tapping 6-19 x 3/8" (4 used)
	3-140079	SCREW, tapping 6-19 x 1/2" (6 used)
	3-84291M01	SCREW, cable converter
	7-84286M01	BRACKET, hold down
	9-80227B01	CONTACT, female pwr
	9-84151B01	RECEPTACLE, contact
	15-80216B01	CONNECTOR, housing back
	15-84284M01	HOUSING, cable converter
	15-84285M01	COVER, cable converter
	42-80156B01	RING, retainer
	43-84289M01	SPACER
	75-82200H17	PAD, oscillator
	32-83859M01	GASKET, connector

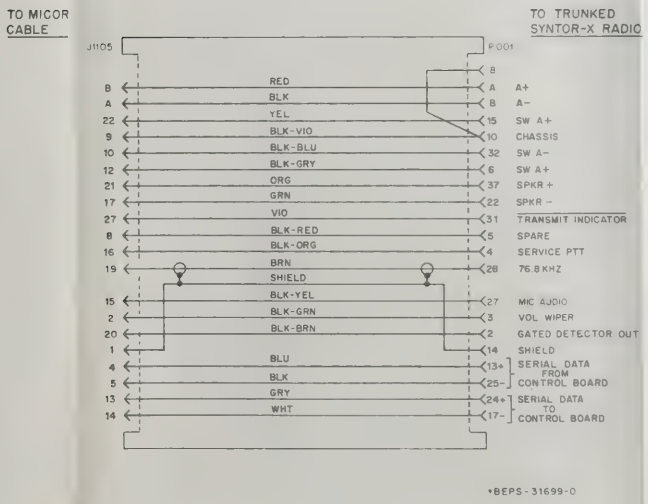
TRN4432A Trunked Control Head Adapter Cable Kit — PL-7270-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	66-84690C01	TOOL, contact removal
	14-84590B06	CONNECTOR, yellow



•CEPS-31698-O

*Figure 2. Trunked **Micor** Cable to Trunked **SYNTOR X** Control Head Wiring Diagrams*



•BEPS-31699-O

Figure 3. TRN4735A Cable Converter Box Wiring Diagram

MICOR™ CABLE CONVERSION KIT OPTION W414AB

(FOR TRUNKED *SYNTOR X*™ COMPATIBILITY)

1. GENERAL DESCRIPTION

An existing trunked *Micor* radio installation can be readily adapted to accept a Trunked *SYNTOR X* radio. Conversion requires a TRN4432A Trunked Control Head Adapter Cable Kit and a TRN4735A Cable Converter Box. Figure 1 shows an existing trunked *Micor* cable wiring diagram.

2. CONVERSION PROCEDURE

Remove the trunked *Micor* radio and control head from the vehicle and proceed as follows.

Step 1. Remove the following wires from the blue connector of the TKN6454B *Micor* Cable Kit (using provided tool, part no. 66-84690C01), and install these wires in the provided yellow connector, part no. 14-84590B06. (Refer to Figure 2.)

Wire Color	Blue Connector (Remove wire)	Yellow Connector (Insert wire)
Gray	Pin 1	Pin 4
Black	Pin 3	Pin 3
Blue	Pin 11	Pin 1
White	Pin 22	Pin 6

Step 2. Tie back the blue connector and remaining wires.

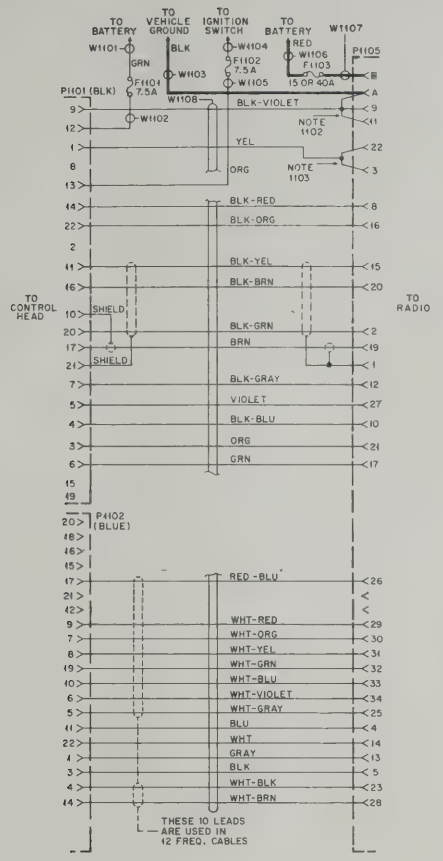
Step 3. Connect the microphone, speaker, yellow, and black connectors into the Trunked *SYNTOR X* control head.

Step 4. Connect the TRN4735A Cable Converter Box to the front of the Trunked *SYNTOR X* radio. Secure with large retention screw on the cable converter box. Figure 3 shows the cable converter box wiring diagram.

Step 5. Connect the modified *Micor* cable to the cable converter box. Secure the cable with the hold down bracket on the cable converter box.

Step 6. Install the Trunked *SYNTOR X* radio and control head into the vehicle.

68P81110E63-O
4/17/81-PHI



•DEPS-31700-O

CABLE

1101 CABLE SHOWN CONNECTED FOR NEGATIVE GROUND OPERATION
1102 BLK-VIO JUMPERS JOINED WITH BLU JUNCTION-LUG
1103. YEL JUMPERS JOINED WITH YEL JUNCTION-LUG

*Figure 1. Trunked **Micor** Cable Kit with Trunked **Micor** Radio Wiring Diagram*

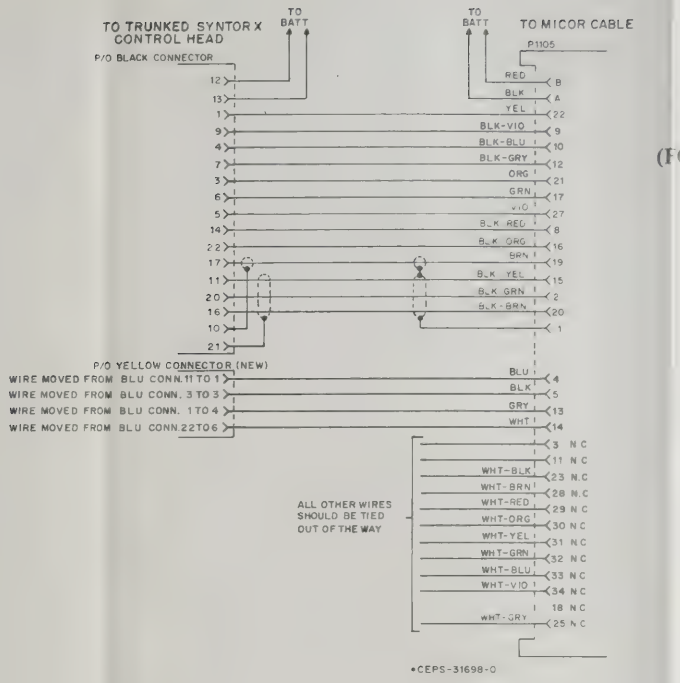
parts list

TRN4735A Cable Converter Box — PL-7271-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1-80726D27	CIRCUIT BOARD
	3-139999	SCREW, tapping 6-19 x 3/8" (4 used)
	3-140079	SCREW, tapping 6-19 x 1/2" (6 used)
	3-84291M01	SCREW, cable converter
	7-84286M01	BRACKET, hold down
	9-80227B01	CONTACT, female pwr
	9-84151B01	RECEPTACLE, contact
	15-80216B01	CONNECTOR, housing back
	15-84284M01	HOUSING, cable converter
	15-84285M01	COVER, cable converter
	42-80156B01	RING, retainer
	43-84289M01	SPACER
	75-82200H17	PAD, oscillator
	32-83859M01	GASKET, connector

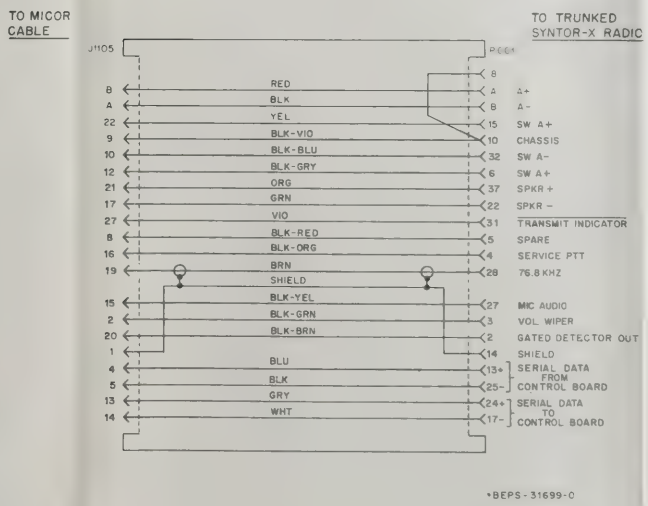
TRN4432A Trunked Control Head Adapter Cable Kit — PL-7270-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	66-84690C01	TOOL, contact removal
	14-84590B06	CONNECTOR, yellow



•CEPS-31698-O

*Figure 2. Trunked **Micor** Cable to Trunked **SYNTOR X** Control Head Wiring Diagrams*



•BEPS-31699-O

Figure 3. TRN4735A Cable Converter Box Wiring Diagram

MICOR™ CABLE CONVERSION KIT OPTION W414AB

(FOR TRUNKED *SYNTOR X*™ COMPATIBILITY)

1. GENERAL DESCRIPTION

An existing trunked *Micor* radio installation can be readily adapted to accept a Trunked *SYNTOR X* radio. Conversion requires a TRN4432A Trunked Control Head Adapter Cable Kit and a TRN4735A Cable Converter Box. Figure 1 shows an existing trunked *Micor* cable wiring diagram.

2. CONVERSION PROCEDURE

Remove the trunked *Micor* radio and control head from the vehicle and proceed as follows.

Step 1. Remove the following wires from the blue connector of the TKN6454B *Micor* Cable Kit (using provided tool, part no. 66-84690C01), and install these wires in the provided yellow connector, part no. 14-84590B06. (Refer to Figure 2.)

Wire Color	Blue Connector (Remove wire)	Yellow Connector (Insert wire)
Gray	Pin 1	Pin 4
Black	Pin 3	Pin 3
Blue	Pin 11	Pin 1
White	Pin 22	Pin 6

Step 2. Tie back the blue connector and remaining wires.

Step 3. Connect the microphone, speaker, yellow, and black connectors into the Trunked *SYNTOR X* control head.

Step 4. Connect the TRN4735A Cable Converter Box to the front of the Trunked *SYNTOR X* radio. Secure with large retention screw on the cable converter box. Figure 3 shows the cable converter box wiring diagram.

Step 5. Connect the modified *Micor* cable to the cable converter box. Secure the cable with the hold down bracket on the cable converter box.

Step 6. Install the Trunked *SYNTOR X* radio and control head into the vehicle.

68P81110E63-O
4/17/81-PHI

MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81043E50-B	Trunked SYNTOR X FM Two-Way Radio 806-870 MHz, 35 W
68P81043E55-B	Trunked SYNTOR X FM Radio Control Station, 806-870 MHz, 10 W
68P81044E40-B	SYNTOR X FM Two-Way Radio 806-870 MHz, 35 W
68P81047E05-O	SYNTOR X2 FM Two-Way Radio 806-870 MHz, 35 W

REVISION DETAILS:

IMPORTANT

The following information applies to changes affecting the Compensation Adjustment, Deviation Adjustment, and Power Output controls and their respective adjustment.

1. Component changes are made to the Model TRN8862A SYNTOR X Common Circuits Board and the Model TRN4721A SYNTOR X2 Common Circuits Board. These changes are the same for both boards and are as follows:

Compensation Adjustment control R516, Deviation Adjustment control R517, and Power Output Control R980 formerly Motorola Part No. 18-83311K06, are now changed to Motorola Part No. 18-82374N09. The value of these controls (10k) remains the same. Make these corrections to the respective parts list in your

instruction manual. These changes cause the circuit boards to be reidentified as TRN8862A-3 and TRN4721A-1.

2. The adjustment of R516, R517, and R980 (Motorola Part No. 18-82374N09) is to be made using alignment tool Motorola Part No. 66-82977K03 (part of TRN4285A or TRN4513A Tuning tool Kits) as shown in Figure A if the RF board shield in your radio set is stamped as follows: "ADJUST WITH HEX TOOL". This stamping will be located by the appropriate adjustment holes in the shield. If the RF board shield is not stamped as previously mentioned, R516, R517, and R980 should be adjusted as in the past (slot type adjustment).

NOTES:

1. IF RF BOARD SHIELD IS STAMPED "ADJUST WITH HEX TOOL," USE HEX END "B" FOR TOP SIDE OF RADIO ADJUSTMENT AND METAL TIP END "A" FOR BOTTOM SIDE OF RADIO ADJUSTMENT.
2. EARLY VERSION ALIGNMENT TOOL MAY ALSO BE USED, BUT REMOVE SMALL HEX END AS SHOWN IN DETAIL "C".
3. DETAIL "C" ONLY ON EARLY VERSION ALIGNMENT TOOL. GAEPS-33558-O

Figure A. Alignment Tool Detail

MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81043E50-B Trunked SYNTOR X FM Two-Way Radio. 806-870 MHz, 35 W

REVISION DETAILS:

A new radio model is now available. The only difference between the comparable models described in your manual and the new model is restructuring of the radio.

Below is a list of the comparable models versus the new radio model.

COMPARABLE MODEL	NEW RADIO MODEL
T45VBJ5G00AK w/W347AB Option	T45VBJ5G00AW

MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81043E50-B	Trunked SYNTOR X FM Two-Way Radio 806-870 MHz
68P81043E55-B	Trunked SYNTOR X FM Two-Way Radio 806-870 MHz

REVISION DETAILS:

Behind the MICROCOMPUTER SYSTEM'S Tab, under section 68P81046E46-B replace diagram PEPS-29545-A with the attached revised diagram PEPS-29545-B.

ATTACHMENTS:

Trunked Filter Board Circuit Board Detail and Parts List. PEPS-29545-B

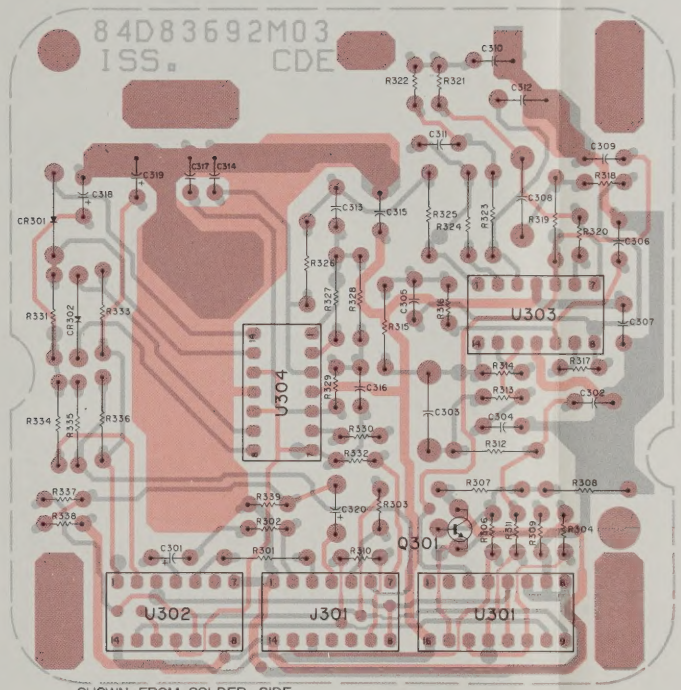
parts list

TRN4274A Filter Board PL-7023-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 5%; 50 V: unless otherwise stated
C301	23-11013D55	4.7 ± 20%; 20 V
C302	8-11017B18	.082 ± 10%
C303	8-82905G34	.15
C304	8-11017B10	.018 ± 10%
C305	8-11017A16	.068
C306	8-11017A15	.056
C307	21-11015A07	.01 + 80-20%; 100 V
C308	8-82905G42	.33 ± 10%
C309	8-11017A09	.015
C310	8-11017A19	.0056
C311	8-11017A09	.015
C312	21-82633E23	600 pF; 100 V
C313	8-11017A18	.0039
C314	8-11017A05	.0033
C315	21-11015A07	.01 + 80-20%; 100 V
C316	8-11017A19	.0056
C317	8-11017A05	.0033
C318, 319	23-11013F57	1 ± 20%; 35 V
C320	23-84538G29	47 ± 20%; 10 V
		diode: (see note)
CR301, 302	48-84616A01	hot carrier
		connector, receptacle:
J301		p/o flat cable & connector assembly
		transistor: (see note)
Q301	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R301	6-11009A49	1k
R302	6-11009E57	2.2k
R303	6-11009E73	10k
R304	6-11009E05	200k
R305		not used
R306	6-84640C76	210k ± .5%; 1/8 W
R307	6-11009A94	75k
R308	6-11009B08	270k
R309	6-11009E66	5.1k
R310	6-11009E73	10k
R311	6-11009E76	13k
R312	6-11009A76	13k
R313	6-11009E76	13k
R314	6-11009E87	39k
R315	6-11009A76	13k
R316	6-11009E76	13k
R317	6-11009E83	27k
R318	6-11009E71	8.2k
R319	6-11009A77	15k
R320	6-11009E82	24k
R321, 322	6-11009E74	11k
R323	6-11009E74	11k
R324	6-11009A85	33k
R325, 326	6-11009A76	13k
R327	6-11009A83	27k
R328	6-11009A73	10k
R329	6-11009E73	10k
R330	6-11009E80	20k
R331	6-11009A01	10
R332	6-11009E79	18k
R333	6-11009A01	10
R334	6-11009A77	15k
R335, 336	6-11009A87	39k
R337	6-11009E57	2.2k
R338	6-11009E89	47k
R339	6-11009E87	39k
		integrated circuit: (see note)
U301	51-82884L54	analog multiplexer
U302	51-82884L14	quad trans. gate
U303, 304	51-83629M09	quad op amp
		non-referenced items
	30-83776M01	FLAT CABLE & CONNECTOR ASSEMBLY
	42-83503M01	RETAINER; 4 used
	3-10943D29	SCREW, tapping; 3.5 x 0.6 x 8mm; 4 used

note: For optimum performance, replacement diodes, transistors and integrated circuits must be ordered by Motorola part numbers.

Trunked Filter Board Circuit Board Detail and Parts List
*Motorola No. **PEPS-29545-B***
4/20/82- PHI



SHOWN FROM SOLDER SIDE

COMPONENT SIDE ● BD-CEPS-29542-A
SOLDER SIDE ● BD-CEPS-29543-A
OL-CEPS-29544-A

revisions

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TRN4274A		PC BOARD CHANGED FROM: 84-83692M01 TO: 84-83692M03	

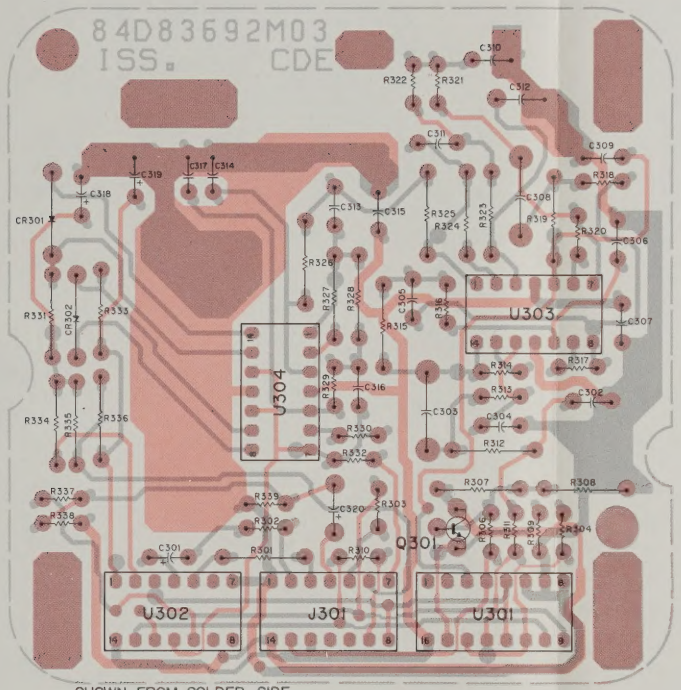
parts list

TRN4274A Filter Board — PL-7023-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 5%; 50 V: unless otherwise stated
C301	23-11013D55	4.7 ± 20%; 20 V
C302	8-11017B18	.082 ± 10%
C303	8-82905G34	.15
C304	8-11017B10	.018 ± 10%
C305	8-11017A16	.068
C306	8-11017A15	.056
C307	21-11015A07	.01 + 80-20%; 100 V
C308	8-82905G42	.33 ± 10%
C309	8-11017A09	.015
C310	8-11017A19	.0056
C311	8-11017A09	.015
C312	21-82633E23	600 pF; 100 V
C313	8-11017A18	.0039
C314	8-11017A05	.0033
C315	21-11015A07	.01 + 80-20%; 100 V
C316	8-11017A19	.0056
C317	8-11017A05	.0033
C318, 319	23-11013F57	1 ± 20%; 35 V
C320	23-84538G29	47 ± 20%; 10 V
		diode: (see note)
CR301, 302	48-84616A01	hot carrier
		connector, receptacle:
J301		p/o flat cable & connector assembly
		transistor: (see note)
Q301	48-869642	NPN; type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R301	6-11009A49	1k
R302	6-11009E57	2.2k
R303	6-11009E73	10k
R304	6-11009E05	200k
R305		not used
R306	6-84640C76	210k ± .5%; 1/8 W
R307	6-11009A94	75k
R308	6-11009B08	270k
R309	6-11009E66	5.1k
R310	6-11009E73	10k
R311	6-11009E76	13k
R312	6-11009A76	13k
R313	6-11009E76	13k
R314	6-11009E87	39k
R315	6-11009A76	13k
R316	6-11009E76	13k
R317	6-11009E83	27k
R318	6-11009E71	8.2k
R319	6-11009A77	15k
R320	6-11009E82	24k
R321, 322	6-11009E74	11k
R323	6-11009E74	11k
R324	6-11009A85	33k
R325, 326	6-11009A76	13k
R327	6-11009A83	27k
R328	6-11009A73	10k
R329	6-11009E73	10k
R330	6-11009E80	20k
R331	6-11009A01	10
R332	6-11009E79	18k
R333	6-11009A01	10
R334	6-11009A77	15k
R335, 336	6-11009A87	39k
R337	6-11009E57	2.2k
R338	6-11009E89	47k
R339	6-11009E87	39k
		integrated circuit: (see note)
U301	51-82884L54	analog multiplexer
U302	51-82884L14	quad trans. gate
U303, 304	51-83629M09	quad op amp
		non-referenced items
	30-83776M01	FLAT CABLE & CONNECTOR ASSEMBLY
	42-83503M01	RETAINER; 4 used
	3-10943D29	SCREW, tapping; 3.5 x 0.6 x 8mm; 4 used

note: For optimum performance, replacement diodes, transistors and integrated circuits must be ordered by Motorola part numbers.

Trunked Filter Board Circuit Board Detail and Parts List
Motorola No. PEPS-29545-B
4/20/82- PHI



SHOWN FROM SOLDER SIDE

COMPONENT SIDE ⊕ 8D-CEPS-29542-A
SOLDER SIDE ⊕ 8D-CEPS-29543-A
OL-CEPS-29544-A

revisions

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
TRN4274A		PC BOARD CHANGED FROM: 84-83692M01 TO: 84-83692M03	

parts list

TRN4274A Filter Board — PL-7023-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ± 5%; 50 V: unless otherwise stated
C301	23-11013D55	4.7 ± 20%; 20 V
C302	8-11017B18	.082 ± 10%
C303	8-82905G34	.15
C304	8-11017B10	.018 ± 10%
C305	8-11017A16	.068
C306	8-11017A15	.056
C307	21-11015A07	.01 + 80-20%; 100 V
C308	8-82905G42	.33 ± 10%
C309	8-11017A09	.015
C310	8-11017A19	.0056
C311	8-11017A09	.015
C312	21-82633E23	600 pF; 100 V
C313	8-11017A18	.0039
C314	8-11017A05	.0033
C315	21-11015A07	.01 + 80-20%; 100 V
C316	8-11017A19	.0056
C317	8-11017A05	.0033
C318, 319	23-11013F57	1 ± 20%; 35 V
C320	23-84538G29	47 ± 20%; 10 V
		diode: (see note)
CR301, 302	48-84616A01	hot carrier
		connector, receptacle:
J301		p/o flat cable & connector assembly
		transistor: (see note)
Q301	48-869642	NPN, type M9642
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R301	6-11009A49	1k
R302	6-11009E57	2.2k
R303	6-11009E73	10k
R304	6-11009E05	200k
R305		not used
R306	6-84640C76	210k ± .5%; 1/8 W
R307	6-11009A94	75k
R308	6-11009B08	270k
R309	6-11009E66	5.1k
R310	6-11009E73	10k
R311	6-11009E76	13k
R312	6-11009A76	13k
R313	6-11009E76	13k
R314	6-11009E87	39k
R315	6-11009A76	13k
R316	6-11009E76	13k
R317	6-11009E83	27k
R318	6-11009E71	8.2k
R319	6-11009A77	15k
R320	6-11009E82	24k
R321, 322	6-11009E74	11k
R323	6-11009E74	11k
R324	6-11009A85	33k
R325, 326	6-11009A76	13k
R327	6-11009A83	27k
R328	6-11009A73	10k
R329	6-11009E73	10k
R330	6-11009E80	20k
R331	6-11009A01	10
R332	6-11009E79	18k
R333	6-11009A01	10
R334	6-11009A77	15k
R335, 336	6-11009A87	39k
R337	6-11009E57	2.2k
R338	6-11009E89	47k
R339	6-11009E87	39k
		integrated circuit: (see note)
U301	51-82884L54	analog multiplexer
U302	51-82884L14	quad trans. gate
U303, 304	51-83629M09	quad op amp
		non-referenced items
	30-83776M01	FLAT CABLE & CONNECTOR ASSEMBLY
	42-83503M01	RETAINER; 4 used
	3-10943D29	SCREW, tapping; 3.5 x 0.6 x 8mm; 4 used

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Trunked Filter Board Circuit Board Detail and Parts List
Motorola No. PEPS-29545-B
4/20/82- PHI